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NATIONAL FIRE PROTECTION ASSOCIATION

Quarterly

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International

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of the

NATIONAL FIRE PROTECTION ASSOCIATION

Vol. 40 October, 1946 No. 2

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Accounts of fires appearing in the Quarterly are copies of or extracts from reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

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Obsolete sprinkler systems installed prior to 1896 failed to protect two large frame factories in Wellesley, Mass., when a flash fire opened numerous sprinklers in the Wellesley Woolen Mills on October 3, 1946. Water supplies consisting of an ancient 4-inch dead end main and small gravity tank proved inadequate and fire swept through an adjoining metal working plant and then jumped more than 100 feet across the Charles River to a wool shoddy mill in the City of Newton. Damage to the three plants totaled approximately $900,000, including business interruption losses. The plants, virtually surrounded by the river and swamplands, were largely inaccessible to fire fighters responding from five communities.

The Quarterly

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Obsolete Fire Protection

The fire pictured on the opposite page is a typical example of the results of reliance upon fire protection facilities of a bygone era to meet the fire hazards of modern industry. In this case the buildings were ancient structures, inaccessible for fire department operations, relying upon an automatic sprinkler system that may have been the last word in protection when it was installed over fifty years ago, but falling far short of present standards. Modern machinery had been installed, the manufacturing processes introduced the hazards and values of 1946, but the buildings and their protection were still characteristic of the quaint New England mill village of the nineteenth century. When fire once gets a start under such conditions, a serious loss is to be expected.

The rapid progress of America in the past 50 or 100 years has often been attributed to our quick adoption of new developments, our eagerness to buy new machines and junk the old whenever a new machine will save time and expense or produce a better product, even though the old machine may still be in good operating condition. Unfortunately, however, no comparable development has occurred with respect to the construction and protection of buildings. Until recent years, perhaps, this has had no very significant effect upon fire losses, but current fire experience clearly reflects the results of continued reliance upon building construction and protection of the "horse and buggy" era in this age of modern industry and new inventions bringing new fire hazards, greater concentrations of value, and often increased danger of loss of life by fire.

The record shows that fires due to deficiencies in construction and protection are by no means limited to old buildings, but the older structures present a special problem because once considered adequately protected they are likely to be forgotten by fire protection people who are concentrating their attention upon new construction.

There is no easy solution to this problem, but one plan that has been proposed would go a long way towards meeting it. This is that buildings, their fire protection facilities and appurtenances, designed for some specified period of use, say 40 or 50 years, should at the end of this period be removed or be revamped to comply with all then existing requirements for fire safety. Tax laws now recognize depreciation and obsolescence; why should not building laws be so revised that a permit for the erection of a building will be good only for a specified period of years, depending upon the construction and occupancy of the building, instead of in perpetuity? Under such a plan, at the expiration of the specified period of life, the building owner would be required to remove the structure, or to make such changes as might be needed to make it comply with all life- and fire-safety requirements for new buildings.

Meeting of Board of Directors.
East Providence, July 15, 1946.

Present.

George W. Elliott, Chairman
Curtis W. Pierce, President
Earl O. Shreve, Vice-President
John L. Wilds, Vice-President
Hovey T. Freeman, Secretary-Treasurer
David J. Price, Past President
Richard E. Vernor, Past President

Malcolm S. Blake	Jack C. Curtis
A. L. Brown	Russell Grinnell
Hylton R. Brown	John A. Neale
Allen L. Cobb	H. E. Newell

John W. Strohm

Percy Bugbee, General Manager
Robert S. Moulton, Technical Secretary
Horatio Bond, Chief Engineer
George H. Tryon, III, Engineer

Business Transacted.

1. In accordance with the vote of the annual meeting the following officers were elected: President, Curtis W. Pierce; Vice-President, Earl O. Shreve; Vice-President, John L. Wilds; Secretary-Treasurer, Hovey T. Freeman; Chairman, Board of Directors, George W. Elliott.

2. The Advisory Committee for 1946-47 was appointed as follows: George W. Elliott, Chairman, Curtis D. Pierce, Earl O. Shreve, John L. Wilds, Hovey T. Freeman.

3. A. L. Brown and Lloyd T. Wheeler were elected to complete the personnel of the Nominating Committee for 1947.

4. It was voted to refer the selection of the place and dates of the 1947 annual meeting to the Advisory Committee with power, with the recommendation that the meeting be a four-day session held not earlier than May 5, 1947, preferably in San Francisco, with Chicago second choice, the selection to be made in the light of the probable availability of hotel and transportation facilities.

5. The President, the Chairman of the Board and the General Manager were appointed as the Program Committee for the 1947 annual meeting, with power to add to the committee members from the city selected for the meetings.

6. On motion of Treasurer Freeman, it was voted to authorize the Finance Committee to establish a Custodian Account at the Second National Bank of Boston for the purpose of handling the invested funds of the Association and collecting the income therefrom.

7. The budget for 1946-47 as submitted by the Finance Committee was approved.

8. The proposed Pension Plan as submitted to the members of the Board by letter under date of July 2, 1946, was approved in principle and referred to the Finance Committee with power to put into effect in the name of the Board.

9. The resignation of Frank A. Epps as chairman of the Committee on Long Range Planning was accepted with an expression of appreciation for Mr. Epps' service. Lloyd T. Wheeler was appointed chairman, and Russell Grinnell and M. S. Blake were appointed members (balance of personnel unchanged).

10. The proposal of Mr. Russell Grinnell that a procedure should be established for the Board's action in selecting candidates for Honorary Membership was approved, and it was voted that the names of candidates for Honorary Membership should be submitted to the Board with the agenda for the meeting at which action is proposed, together with a citation of the qualifications of each candidate.

11a. In accordance with the action of

the Annual Meeting, Chairman Elliott was authorized to appoint a special committee to investigate and report on electric branch circuit protection.

It was voted to suspend the mandatory provision of the 1946 National Electrical Code (Article 240) requiring the use of the so-called Type S fuse, pending the report of the above special committee, to publish the 1946 Code with suitable indication that pending the completion of investigation and further action by the Board or by the Association this feature is permissive rather than mandatory, and to defer submission of the Code to the American Standards Association pending final action on this matter. (Mr. Neale recorded as voting in the negative.)

11b. Revisions in the Standards on Carbon Dioxide Extinguishing Systems, submitted by Committee on Special Extinguishing Systems in accordance with the authorization of annual meeting were approved (text in Agenda item 11b; will be incorporated in next edition of Standards).

11c. Revisions in the Standards on Centrifugal Fire Pumps, submitted by the Committee on Fire Pumps in accordance with the authorization of the annual meeting, were approved (text in Agenda item 11c, subject to minor editorial revision; will be incorporated in the next edition of Standards).

11d. On recommendation of the Manufacturing Hazards Council, as transmitted to the Board by the annual meeting, it was voted to suspend the Manufacturing Hazards Council, and to refer to the Committee on Technical Committee Procedure the question of making other provision for the maintaining of functions of the Council.

11e. The Technical Secretary reported on recommendations from the Chairman of the Committee on Finishing Processes relative to changes in the Standards on Paint Spraying and Spray Booths, and in the Standards on Dip Tanks, which were authorized by the annual meeting for submission to the Board. In the absence of a complete record of the views of the members of the committee, no action was taken.

11f. A revised text for par. 416 of the Tentative Standards on Fur Storage, as proposed by the Committee on General Storage in accordance with the action of the annual meeting was considered, and action thereon deferred until the January, 1947, meeting of the Board, to give opportunity for the conduct of further tests on the effectiveness of various forms of protection for vaults.

11g. The Executive Office was authorized to submit further committee recommendations for changes in Standards, covered by action of the annual meeting, for letter ballot of the Board when received from the committee where prompt action may be needed, otherwise to place such items on the agenda for the next Board meeting.

12. A request from the U. S. Department of Commerce for N.F.P.A. approval of a proposed Commercial Standard on the Flammability of Textiles, TS 4128, was referred to the Committee on Technical Committee Procedure with the suggestion that a procedure should be established for handling matters such as this which do not come under the jurisdiction of any N.F.P.A. technical committee. During the discussion no objection was raised to any technical feature of the proposed commercial standard.

13. Chairman Pierce of the Committee on Technical Committee Procedure made a progress report relative to proposals for reorganization of the Electrical Committee.

14. Committee appointments were confirmed in accordance with list submitted with the agenda for the meeting; the

Committee on Technical Committee Procedure was authorized to make further technical committee appointments prior to the publication of the 1947 Year Book, subject to confirmation by the Board at its next meeting, and all members of the committee not otherwise mentioned were reappointed for 1946-47.

15. It was voted to suspend the Committee on Aviation and on Aircraft Fire Fighting and to create a new Committee on Aviation and Airport Fire Protection. The personnel of the new committee was appointed, subject to additional future appointments. (See committee listing in 1946-1947 Year Book.)

16. A vote of appreciation was extended to the N.F.P.A. staff for their effective work in planning and carrying out the details of the 50th Annual Meeting.

17. Life safety from fire in hotels was discussed, and members of the staff reported on various staff activities on this subject.

Safeguarding Hazards of Flammable Clothing.

By Charles W. Dorn.*

Mercantile interests and public authorities have been aware of the hazards to life of certain types of wearing apparel for four or five years. At first there were only a few scattered instances where some person's garments caught fire, resulting in severe burns or, in some instances, death. It is interesting to note that the vast majority of these accidents take place in the wintertime, when the humidity is low and the air is comparatively dry in many dwellings. There are some fabrics that are hazardous under dry conditions and comparatively safe in the summer time when the humidity is high. In one instance a woman wearing a garment with buttons on it made of cellulose nitrate was very badly burned, and a long and lengthy study of this button problem took place at that time. We were able to determine that the hazard did not depend as much upon the material from which the button was made as on the shape of the button. It was found that the cellulose nitrate button worn by the woman was made in the shape of a flower, with a great many thin, serrated, pointed edges. These edges offered a surface for very quick ignition. The same material used in a solid button is relatively slow to ignite, but when once ignited burns violently.

Burns due to the ignition of clothing began to occur more frequently, and finally, about a year and a half ago, a tragic incident occurred in Washington, D. C., where three small boys were burned to death and seven others very seriously injured from the chaps of their cowboy suits, which were ignited by a bonfire. When a spark hit these chaps, they burned so rapidly that there was no chance whatsoever for the wearer to get rid of the garment. About that same time the State of

*Mr. Charles W. Dorn is director of the Research Laboratory of the J. C. Penney Company, New York, and chairman of the Technical Committee of the National Retail Dry Goods Association. This article was presented as a paper at the 50th Annual Meeting of the National Fire Protection Association in Boston, June 3-7, 1946. Mercantile interests, as well as the American Association of Textile Chemists and Colorists, also represented by Mr. Dorn, have cooperated with the National Bureau of Standards and other interested public and private organizations in establishing criteria for determination of the hazards of flammable garments.

California introduced legislation to prohibit the sale of flammable merchandise in that state. The first bill to be introduced stated that it would be unlawful to sell any textile that was more flammable than cotton in its natural state. However, no one can tell what cotton in its "natural state" is. Obviously the legislation was not sound and it was later changed. At the present it is in the hands of the California State Fire Marshal to determine which textiles are hazardous and which are not hazardous.

Proposed U. S. Law.

A bill similar to that passed in California was introduced in the U. S. Senate by Senator Leroy Johnson of California. This bill, HR 2496, obviously was not usable. Senator Johnson later introduced a second bill, based on a test method developed by the Bureau of Standards, to outlaw any pile or nap fabric which would burn faster than a specified rate. In the new Johnson bill there is no distinction between wearing apparel and household goods. If such a bill were passed, we would eliminate from the market today the vast majority of cotton blankets and practically all of the chenille bedspreads which, after years of use, have shown themselves to be a relatively small hazard.

What Is the Problem?

Everyone knows that our ordinary clothing will burn. But what we have been trying to do is to separate from this broad group of wearing apparel those garments, those textiles or those materials which will burn so rapidly if ignited that the wearer cannot divest himself of the garment. The National Retail Dry Goods Association, becoming aware of this situation, contacted the American Association of Textile Chemists and Colorists and asked them to develop a test method to differentiate between ordinary and hazardous fabrics. A committee went to work on this problem and in about fifteen months' time developed apparatus which will accomplish the desired purpose. Many hundreds of tests have been made with this device and it has been found that these results are reproduceable. We have been able to obtain parts of garments that have caused serious accidents and have been able to rate these garments on the machine. From our studies we have reached a conclusion that any material when tested on that machine which will burn at a rate greater than six seconds for the length of the sample (a little less than six linear inches) is considered a hazard and should not be used in wearing apparel. The garments which we were able to obtain that had caused injuries all burnt at a rate ranging from one to three seconds on that machine. We doubled that rate for a margin of safety.

From its studies the committee reached the conclusion that wool, silk and nylon offer no flammability hazard. Cotton is as flammable as regenerated type rayon under identical construction and testing conditions. With cotton having a normal moisture content of six and one-half per cent, as compared to the regenerated type of rayon with eleven per cent, it is reasonable to conclude that cotton will come to the critical point much more rapidly than rayon. If all these samples of any one fabric are in identical condition as to moisture content and physical condition of that which is being tested, a very close correlation of test results by one laboratory or by other laboratories can be obtained, as has been shown by the many tests that the committee has made.

Certain coated fabrics, although generally slow to ignite, burn with a violent flame that is difficult to extinguish and, therefore, offer a very definite hazard.

Along those lines we have had several instances where people have been very severely burned, or burned to death, wearing pyroxylin coated fabrics. There is one case on record in New Jersey where a young girl wearing a pyroxylin coated apron was alone at home. She was baking a cake and reached into the oven with the apron around her hand and grabbed the hot pan. Flame apparently did not come in contact with the apron, but the heat of the pan was sufficient to ignite it. That girl was burned to death.

There is another incident in Pittsburgh in which a young girl was hanging up wash in the kitchen, standing on a stool, and the edge of her apron came in contact with the top of a hot stove. That girl received third degree burns. I don't know whether she survived or not; I doubt it.

It is not only the nap and pile fabrics that cause trouble, but certain types of net garments; evening dresses that are made of nets similar to lace curtain types of material have caused deaths. There was one very serious accident in Vermont several years back, one in the lobby of a theatre in New York, and just two or three weeks ago an Austin, Texas, college girl wearing a net dress was burned to death. She was attending a sorority initiation. There were lighted candles in the room and when she backed into one the dress went up like a puff of powder.

Action Is Taken.

What has been done to correct these conditions? We have developed the test machine. The method of test has been turned over to the National Bureau of Standards and at the present time is in the active process of being made a Commercial Standard. The advance copy of the Standard states:

"The purpose is to reduce danger of injury and loss of life by providing, on a national basis, standard methods of testing and rating the resistance of textiles and manufactured textile products to igniting and flashing and a means of identification of textiles and textile products that conforms to the requirements of this standard. [It will also serve as a guide to manufacturers in offering for sale to be used as wearing apparel only textiles which are not hazardous.]

"Scope: The standard provides methods for testing textiles and manufactured textile products for flammability. It established minimum requirements which such textiles and textile products shall meet to be considered as non-hazardous and provides for labeling to assure the purchasers that they are obtaining fabrics or products which will not prove to be a fire hazard and thereby are not a menace to life."

At the same time a bill has been drawn which we hope to have introduced in Congress. The bill would prohibit the movement in interstate commerce of fabrics and articles of wearing apparel made therefrom which are so highly flammable as to be dangerous when worn by persons or used for other purposes. Among other provisions the bill contains definitions: "The term fabric means any material woven, knitted, felted or otherwise produced from any natural, synthetic or other material," purposely worded in that manner to include unsupported plastic materials, some of which are quite hazardous.

Transactions in dangerously flammable fabrics are unlawful in the proposed legislation. The standard of flammability as set up is as follows: "No fabric or article of wearing apparel made therefrom shall be deemed so highly flammable under the provisions of this act as to be dangerous when worn by person if, when tested under the conditions and in the manner prescribed therefor in the then effective

Commercial Standards promulgated by the Secretary of Commerce, it is not set on fire, or if set on fire burns without a flame, or with a flame which does not burn, flash, or spread at a rate greater than that specified by the aforementioned Commercial Standard, or at a rate of not more than five linear inches thereof during each six seconds of burning, whichever is the more severe test."

We have purposely tried to leave the test method as flexible as possible. We think we have the answer. Only time is going to prove whether we are right. In making the Commercial Standard a basis, we have the right, whenever it becomes necessary, to change those standards, both as to method of tests and as to rate of burning, providing we do not exceed the limit set forth in the bill. The limit was set purely as a brake so that fabrics cannot be produced under more lenient requirements than stated in the law.

The proposed law further provides that the enactment and enforcement of the set-up shall be carried on by the Federal Trade Commission.

This is a brief survey of the status of this problem as of the present date.

Test Apparatus and Method.

The test apparatus which we have developed can be purchased through the U. S. Testing Company at Hoboken, N. J.

The apparatus includes an oven in which samples of fabrics have been dried for 15 minutes at a temperature of 105° C. and desiccated over calcium chloride for not less than five minutes. The samples are cooled in a dry atmosphere and are then ready for testing. Not more than 45 seconds should elapse from removal from the desiccator to the application of the flame.

Pure butane gas is used to provide the igniting flame. We decided to use a bottled gas rather than to trust to the variation in illuminating gas which is found throughout the country. In testing with the apparatus the sample is held in place at a 45-degree angle. We would prefer to test the sample vertically, but in many instances our rate of flashing is so rapid that we have had to resort to a 45-degree angle to get a measurable rate of burning. There is a cord across the top of a grid on which the sample rests, which is attached to a weight which will automatically stop a stop-watch as soon as the cord is burned through. The stop-watch is actuated as the flame is applied to the test sample. The machine is devised so that the flame is in contact with the test sample for one second only and is then automatically withdrawn. (See illustration on page 82.)

We also use a combing device with this machine which raises nap on nap fabrics to a condition similar to that found in ordinary wearing apparel. It is simply an automatic device which will draw the fabric under a comb, under a stated pressure, without the human element becoming involved. (See illustration on page 83.)

A particular sample will fall into the non-hazardous class of wearing apparel, burning at a rate of eight seconds from the time the flame is impinged on the surface until it travels upward to break the cord. In making tests the results of five tests are always averaged. If the average is below six seconds, the fabric has failed the test. If any one of the tested samples burns at a rate greater than five seconds, the test is thrown out, and duplicate tests are made.

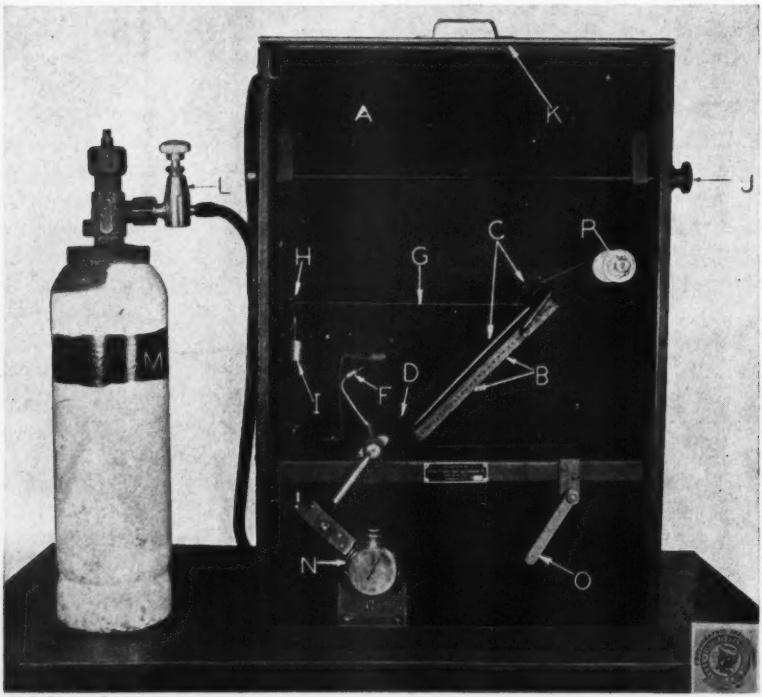
Our test method was designed originally for woven and knitted fabrics. We believe that this same method of testing will work satisfactorily on certain types of coated fabrics but find that we have to increase our length of time in contact with the flame. In rating the coated fabrics we

are working on a basis of the volume of flame developed rather than the rate of burning, because most of them don't burn up in five or six seconds. Coated fabrics start to burn slowly, but before they are consumed there are flames coming out of the top of the testing apparatus. There is an active subcommittee of the Coater's Institute working on coated fabrics at the present time and another subcommitee working on unsupported films and sheeting.

New Products.

The question has been asked as to whether or not we have attempted to solve our problem by flameproofing clothing textiles which will meet the test of washability. There are two flameproofing products coming on the market at the present time and possibly a third which will meet this test. A product developed by Bancroft, known as Ban-Flame, will meet washability requirements and also will meet drycleanability requirements. They are actively testing now to determine whether those statements are correct. The Ellicott Laboratories, in Lawrenceville, New Jersey, have a product that looks very promising. The DuPont Company also is working on a product that has great possibilities.

As far as we can tell, as far as tests have



U. S. Testing Co., Inc.

Flammability Tester. A, draft-proof chamber with adjustable top; B, specimen rack; C, specimen shield; D, indicating finger; F, gas nozzle; G, stop cord; H, pulley or eye; I, stop weight; J, slide door control; K, slide door; L, fuel control valve; M, butane container; N, stop watch and timing mechanism; O, starting lever; P, cord supply; Q, cord loop. Control knobs and draft ventilator strip not shown.

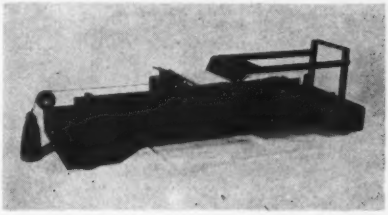
gone, we can wash fabrics with these treatments almost indefinitely. They seem to stand up exceptionally well and also can be dry-cleaned repeatedly. However, we have not had these compounds long enough to obtain an evaluation of the time element under natural moisture conditions, but have made accelerated tests. Samples have been exposed for periods of 80 to 100 hours and longer. Toxicity tests have been made on fabrics treated with the three treatments mentioned above and so far they have all proved to be non-toxic.

In connection with flameproofing treatments of fabrics it is interesting to know that acetate rayon as a rule doesn't offer much of a fire hazard, but if acetate rayon is treated with certain flameproofing compounds, it becomes a very violent hazard.

In hospitals it is not practicable to prevent smoking. However, it is possible to develop a non-flammable sheet or spread so that when patients smoke in bed there will be fewer fires. Of course, wool blankets used in the hospital offer relatively little fire hazard. Wool will not ignite from a glowing cigarette, and even though a flame is applied, it is apt to go out.

Other Fabrics.

We have limited our work entirely to wearing apparel, but in an ordinary home almost all draperies are highly flammable and will burn in a second, particularly if they are net draperies, which burn very rapidly. Nearly every fire or building code states that draperies in night clubs and theatres should be flameproof. In the inspection business there has been no other way than to cut a sample of material and put a match to it. I do not believe that our clothing fabric testing apparatus is satisfactory for testing flameproof draperies, as it is designed only to distinguish between clothing materials that will burn very rapidly and those which burn at a relatively slow rate. Tests for flammability of flameproofed draperies in public buildings should use a different type of test in which a flame is applied to a strip sample and held there for a given period of time, and then the rate of burning, amount of char, and the rate of after-glow recorded.



U. S. Testing Co., Inc.

Combing device.

Editor's Note: At the conclusion of Mr. Dorn's address Mr. Joe Yockers, State Fire Marshal of California, complimented Mr. Dorn and his committee for the splendid manner in which they have worked with the California authorities on this problem, for which no testing apparatus or standards had been developed. He also stated that the N.F.P.A. likewise is in a position to work with Mr. Dorn's committee and to assist in the dissemination of their message to the fire service.

Safety Ventilation for Ovens and Dryers.

By J. B. Smith,
Engineer, Associated Factory Mutual Fire Ins. Cos.

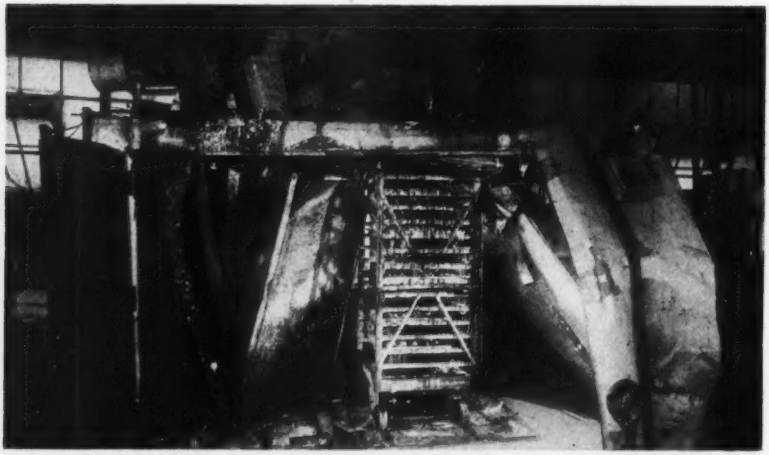
The purpose of this discussion is to suggest what is believed to be the most dependable safety ventilation arrangement for industrial ovens and dryers in which flammable liquids are evaporated, and to call attention to its advantages over other arrangements in common use for diluting vapors of flammable liquids evaporated from materials being heated in industrial ovens. The important feature is a separate safety exhauster which draws all the air needed for ventilation from the oven and discharges it to outdoors.

Although the greater reliability of "mechanical" as compared with "natural" ventilation has been recognized for many years, little distinction has been made between the "separate" safety exhauster and the less reliable arrangement of a single recirculating fan producing safety exhaust by "spilling" a fraction of the total air it handles.

Careful studies of industrial paint ovens and the causes for solvent vapor explosions in them show that the two factors required for an explosion are an accumulation of vapors mixed with air at Lower Explosive Limit concentration or higher, and the presence of an ignition source. It is almost always practical to prevent the accumulation of an explosive mixture by diluting the vapors with adequate safety ventilation, but, on the other hand, it is seldom practical to eliminate all ignition sources.

Analysis of a number of oven explosion

This article was presented as an address at the 50th Annual Meeting of the Association in Boston, June 3-7, 1946.

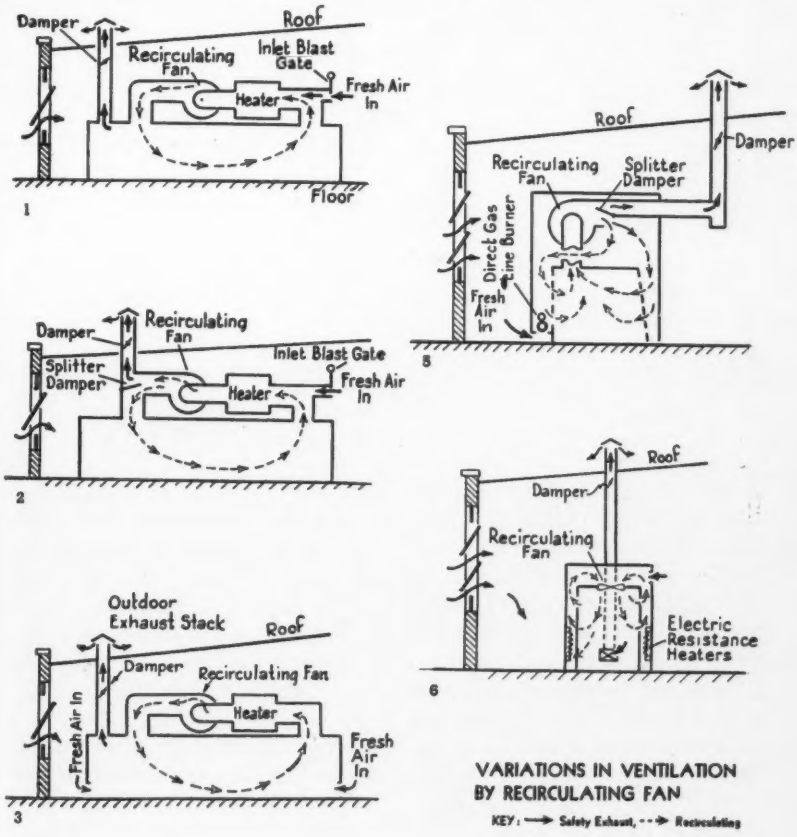


This coil-baking oven was "safeguarded" against explosion. Recent engineering research clearly defines the reasons why safety ventilation sometimes fails, and points the way to a more reliable method of safeguard.

losses for a recent seven-year period covering 49 explosions in a good cross section of American industrial plants, showed that the most important factors in determining if an explosion hazard existed were the type of work being heated and the reliability of the safety ventilation arrangement. Size, that is, the internal volume of the oven, seldom proved to be important.

The types of work most frequently involved were: 1. paint dipped metal parts; 2. coated, dipped or impregnated absorbent materials, such as textiles, cardboard and wooden parts; and 3. varnished-insulated electrical equipment, such as motor

FIG. 1. VENTILATION METHODS IN COMMON USE. Some of the variations of the dual-purpose system are shown here. In each case, safety exhaust is given secondary consideration and is left to a "spilling" of a fraction of the recirculated air up the flue.



VARIATIONS IN VENTILATION BY RECIRCULATING FAN

KEY: → Safety Exhaust, - - → Recirculating

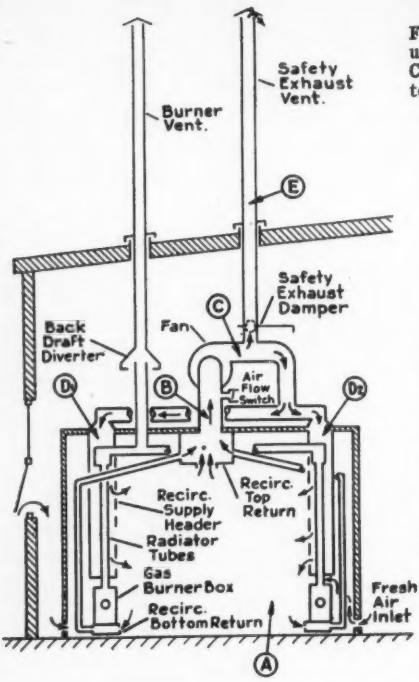
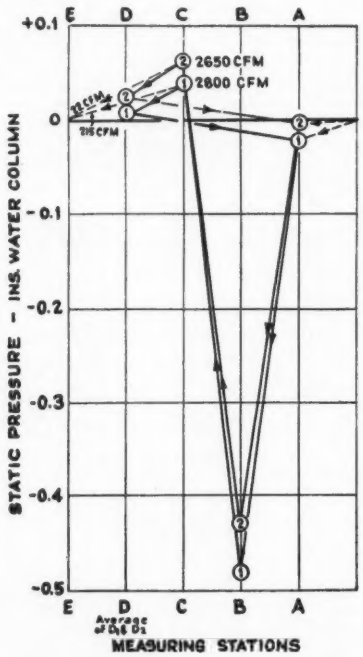


Fig. 2

TEST PROCEDURE—Japan Oven. Air Flows or Static Pressures, or both, measured at different stations, designated A, B, C, etc., for following damper position. Oven temperature, 80° F.

Test No.	Damper Positions
1	Exhaust wide open.
2	Exhaust closed.



2-a

armatures, stators and transformer coils.

Of course adequate ventilation requires having at all times the minimum air flow required by established safety standards. This is 350 cubic feet per minute (referred to 70° F.) per gallon of flammable liquid in a batch process oven work charge, and 10,000 cubic feet (referred to 70° F.) per gallon of flammable liquid entering a continuous process oven. It is fairly certain that in all 49 explosions such an amount of ventilation was not being furnished.

The type of safety ventilation arrangement most frequently involved in the 49 explosions was a single fan recirculating the oven atmosphere and spilling a fraction of the air handled to outdoors as safety exhaust, as shown in Fig. 1. In each case safety exhaust is given secondary consideration and is left to a "spilling" of the exhaust up the stack.

In several industrial finishing rooms, safety ventilation stacks on ovens having this type of safety ventilation arrangement had been observed to be cold to the touch owing to reverse flow of cold air into the

	Fig. 2		Fig. 3		
	Position of Control Dampers		Position of Control Dampers		
	Exhaust Open	Exhaust Closed	Inlet Closed; Exhaust Open	Inlet Open; Exhaust Open	Inlet Open; Exhaust Closed
Safety Ventilation Air Flow	215 C.F.M.*	22 C.F.M.	340 C.F.M.	2250 C.F.M.	900 C.F.M.
Total Flow through Recirculating Fan.....	2800 "	2650 "	3030 "	4350 "	3310 "
Static Pressure Rise through Fan from Inlet to Outlet Stations	0.52 In.W.G.†	0.49 In.W.G.	1.33 In.W.G.	1.51 In.W.G.	1.25 In.W.G.
Suction Pressure Available to Draw Safety Ventilation into System.....	–0.02 "	–0.005 "	–0.92 "	–0.73 "	–0.25 "
Exhaust Pressure Available to Force Safety Ventilation out of System.....	0.04 "	0.06 "	0.0 "	0.20 "	0.52 "
Total Static Head Developed by Recirculating Fan Available to Produce Safety Ventilation..	0.06 "	0.065 "	0.92 "	0.93 "	0.77 "

*Cubic Feet per Minute. †Inches, Water Gage.

The above chart shows the static pressure heads producing recirculation and safety ventilation for different damper adjustments in the tests.

oven from outdoors when spray booth and other fans reduced room pressure to a value slightly below outdoor atmosphere pressure. Having in mind this unsatisfactory experience, the characteristics of this single-fan recirculating-safety-ventilation arrangement were investigated from the standpoint of its ability to furnish rated air flow under the year-round conditions to be expected in industrial plants.

Although it is generally recognized by special hazard engineers that natural gravity ventilation has been proved by explosion experience to be unreliable and dangerous when used for dilution of solvent vapors in ovens, it is unfortunately true that there are still many ovens evaporating flammable liquids using this system. Its unreliability is due to the ease with which local conditions to be expected in industrial plants (namely: room ventilating and other fans, restricted fresh air supply to the oven room in cold weather, increase in oven exhaust duct resistance by condensed paint fumes and outdoor wind conditions) can reduce, block off, or even reverse, the oven-safety-ventilation air flow.

In the case of the single, dual-purpose, recirculating-safety-ventilating fan, these same local conditions have been found to upset all too easily the delicate balance between the fraction exhausted and that recirculated. In this case, almost 100 per cent of the air handled by the fan is recirculated, and practically no fresh air is drawn into the system from the room and discharged to outdoors.

Figs. 2 and 3 show typical ovens and graphs of the pressure gradients for recirculation and flow into and out of the ovens. These illustrate how, on a typical oven having the single recirculating safety-

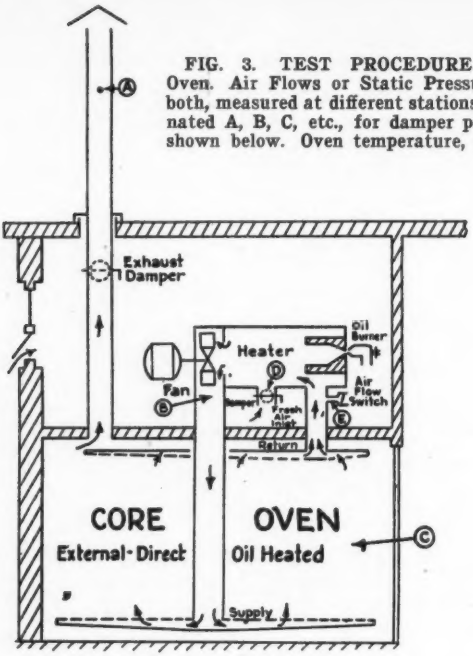
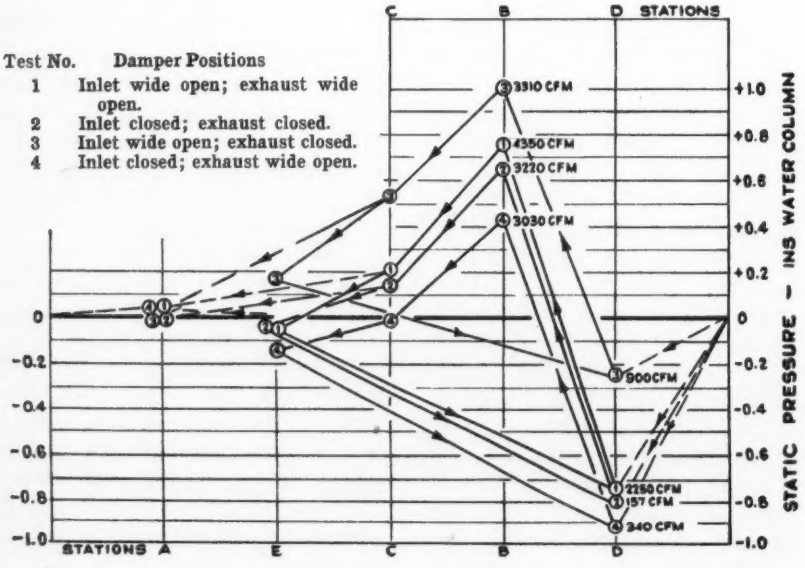


FIG. 3. TEST PROCEDURE — Core Oven. Air Flows or Static Pressures, or both, measured at different stations, designated A, B, C, etc., for damper positions shown below. Oven temperature, 125° F.



exhaust fan, the major part of the head developed by the fan is available for recirculation, but only a small fraction, which is easily overcome by local conditions, is available for safety ventilation (see chart on page 87).

Air flow and static pressure gradients on the duct work of typical ovens equipped with this method of safety exhaust were measured in tests made on two ovens representative of those found in industrial plants. These tests confirm the unreliability of such arrangements.

The ventilating and heating layout of a japan oven, subject to the first test, is shown in Fig. 2. The accompanying graph, 2-a, shows the static pressure gradient and air flow when the safety exhaust damper was placed in the "open"; then when in the "closed" position.

Fig. 3 shows a core baking oven, also tested. Measurements are shown on graph 3-a.

We have no record of an explosion in mixtures of evaporated core binder and air; and accordingly special safety ventilation to dilute such mixtures is not ordinarily advised. However, positive exhaust to rid the oven of evaporated binder is generally considered necessary for satisfactory baking. The relatively high positive pressure within this oven is to be noted and this admittedly produces a somewhat more reliable safety ventilation condition. Even so, this arrangement would have the disadvantage of producing outward leakage of fuel through joints, which would be detrimental in a finishing room where cleanliness is usually important.

It is interesting to note that the air flow switch which closes its contacts on a negative pressure, with respect to atmospheric (room) pressure, was installed in the duct system at a point where the static pressure is always nearly atmospheric and, depending on the damper settings, may be either positive or negative. As would be expected, trouble from false operation finally required the user to discard the switch and interlock the recirculating fan with the heater by taking power for the fuel valve from the load side of the fan starting switch.

Fig. 4 illustrates what is considered to be the most reliable safety exhaust arrangement and the one which should generally be recommended. This fan is ordinarily small as compared with the recirculating fan, and since the head which it develops can economically be made reasonably high, the usual small variables tending to reduce its flow have little effect, as they are resisted by appreciable increases in the developed head. This makes for a system which tends, rather positively, to maintain a constant safe minimum amount of designed safety ventilation and at the same time avoids the inefficiency of over-ventilation.

Safety ventilation measurements on ovens installed in industrial plants have shown in a majority of instances that actual measured air flow is appreciably less than the designed value specified on the oven manufacturer's blueprints. This is probably owing to the fact that oven manufacturers, plant managements and inspectors rarely check the amount of safety ventilation by air flow tests. We would have little confidence in the adequacy of water supplies to sprinkler systems without flow tests, and it hardly seems logical to recommend standard amounts of oven safety ventilation without even checking them by air flow measurements, which are no more difficult to make and result in less inconvenience at the plant than full flow tests of fire streams.

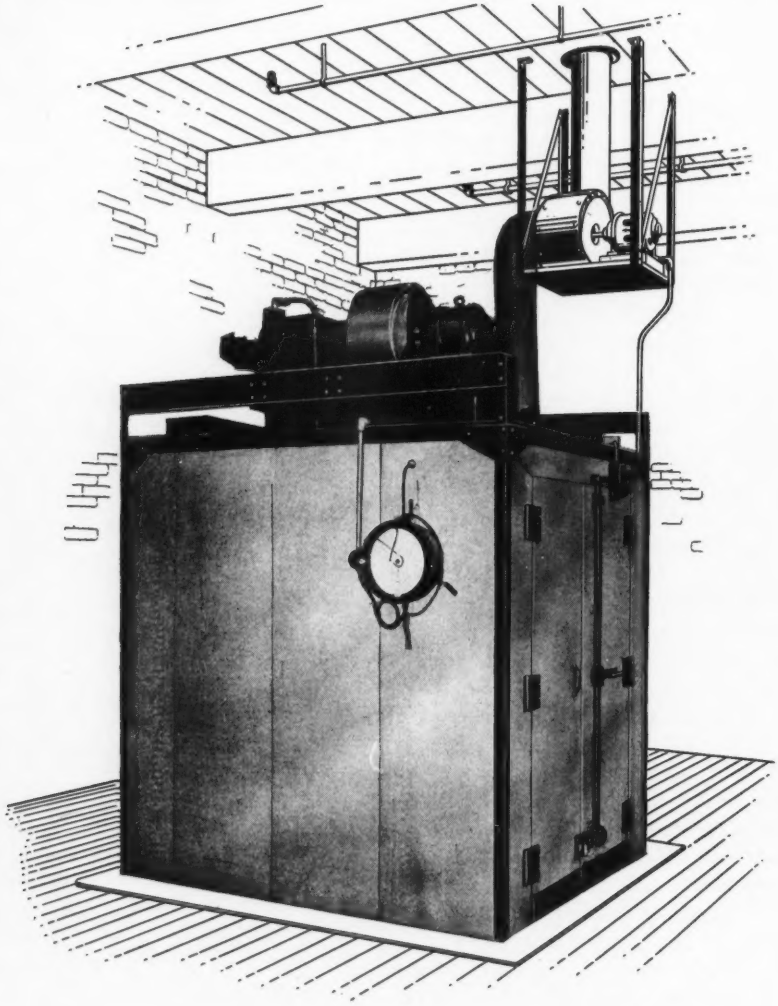


FIG. 4. A SEPARATE FAN INSTALLED. This is one of six typical arrangements (No. 1) appearing in Fig. 1, shown with separate exhauster added to provide a more dependable me'hod of safety ventilation. For all six oven arrangements, the only reliable safety exhaust consists of similar installations of separate centrifugal exhausters.

Conclusions.

Summing up, the following conclusions are indicated:

1. The most reliable safety ventilation arrangement, for diluting vapors from flammable liquids evaporated in ovens and dryers, consists of a separate safety exhaust fan of the centrifugal type drawing all of the air it handles from the oven and discharging this same amount to outdoors. This fan should furnish safety ventilation in the standard amounts mentioned above for continuous and batch process ovens.

2. Such an arrangement should be recommended for all industrial ovens, without regard to size, in which appreciable amounts of flammable liquid are evaporated, especially ovens baking work such as paint-dipped metal parts, absorbent materials such as textiles, paperboard or wood containing flammable finishes or binders, and varnish-impregnated electric insulation on armatures, stators and coils.

3. It is recommended that industrial plants purchasing ovens require the oven manufacturer to furnish proof of the adequacy of safety ventilation in the form of air flow tests made after installation at the purchaser's plant under the most severe local conditions to be anticipated. In the case of existing ovens, air flow tests should also be made at periodic intervals to insure that adequate safety ventilation is being furnished to care for the amount of flammable liquid being introduced.

4. In investigating the safety ventilation of a particular oven installation from the explosion hazard standpoint, it is necessary to consider how air will flow from outdoors into the building, through the building into the oven room, into the oven through the oven ductwork, out of the oven into the fan, out of the fan through the exhaust stack to outdoors. Conditions which will dangerously reduce safety ventilation may be present at any of these locations along the abovementioned circuit as the air flows from outdoors back again to outdoors.

Meeting of the N.F.P.A. Electrical Committee, Stevens Hotel, Chicago, October 8, 1945. This picture was taken from the back of the room.

The N.F.P.A. Electrical Committee.

Electricity or, more properly, the "misuse of electricity" is listed as one of the principal fire causes. The widespread use of electricity, and the potential fire or life hazard inherent in every wire and electrical appliance would introduce a terrible menace to life and property if the use of electrical energy were not carefully controlled in the interest of public safety. While fire losses of electrical origin are still very large, as measured in dollars, the record is excellent in comparison with the potential hazard.

The safety record in the American use of electrical energy is not the result of mere chance. A small group of public-spirited engineers, members of the Electrical Committee of the National Fire Protection Association, have worked almost anonymously for 54 years to improve electrical safety. If these gentlemen needed an enduring monument to mark their unselfish contributions to the daily well-being of us all, it would be the N.F.P.A. National Electrical Code, the "Bible of the Electrical Industry" and the safety blueprint which protects even the simplest electrical installation. By originating competent standards these men have zealously safeguarded electrical safety in the United States from the dawn of the industry when almost any electrical product or wiring job "got by" to the near perfection that is represented by the 1947 N.F.P.A. National Electrical Code which was adopted at the N.F.P.A.'s Fiftieth Anniversary meeting in Boston, June, 1946.

The history of the N.F.P.A. Electrical Committee goes way back to 1892 — thirteen years after Edison produced his first high-resistance lamp and the same year that another group of brilliant electrical engineers founded the General Electric Company. The history of the N.F.P.A. Electrical Committee shines as bright as any beacon in this light-giving industry. Their work is the history of American electrical safety itself.

On May 3, 1892, C. M. Goddard, Secretary of the New England Insurance Exchange and President of the N.F.P.A. from 1908 to 1910, addressed a small group of men by letter,[1] pointing out the desirability of regulating the new force of electricity. From this humble beginning the N.F.P.A. Electrical Committee was born.

Members of the original Electrical Committee[2] were elected at a meeting in New York City on December 6, 1892, at which meeting the Underwriters' National Electrical Association (forerunner of the N.F.P.A. Electrical Committee) was organized.

A conference of the new association was held from August 18-20, 1892, in New York City, at which: first, a set of "Proposed Safe Wiring Rules" was drafted; and second, it was decided to send a copy of these rules to insurance electricians throughout the U. S. and Canada. It was further decided to call another meeting in New York City for permanent organization of the association and for further consideration of the rules.

Thus, on December 6, 1892, insurance representatives from the United States as far West as San Francisco and as far South as New Orleans, as well as several from Canada, were represented at the meeting. Articles of association were adopted and

the usual officers were elected.

On March 20, 1893, rules resulting from the December, 1892, meeting were sent out in print as the "Rules of the Underwriters' International Electrical Association," and in December of the same year the annual meeting of the Electrical Committee was held in New York and revisions of the "rules" were made. It was announced in the summer of 1894 that rules of the Association had been adopted by all the capital stock fire insurance underwriting organizations. At the meeting the National Board of Fire Underwriters agreed to assume sponsorship of the rules, and the name of the association was changed back to the "Underwriters' National Association." The rules resulting from the December, 1894, meeting were promulgated as the "Rules of the National Board of Fire Underwriters as recommended by the Underwriters' National Electrical Association."

In the early part of 1897 the name "National Electrical Code" was adopted and the first edition of the National Electrical Code was distributed. In 1911 the Electrical Committee of the Underwriters' National Electrical Association, at its own request, was made a part of the National Fire Protection Association, under whose sponsorship it has since functioned.

The N.F.P.A. Electrical Committee's primary function is the preparation and revision of the National Electrical Code. The N.F.P.A. Electrical Committee at the present time consists of a Chairman, a Secretary, 48 voting members, 53 alternates and a number of cooperating representatives who participate without formal vote in the main committee. The Chairman of the Committee is appointed by the Board of Directors. Other officers may be elected by the Electrical Committee. The members and alternates are designated by cooperating organizations and are appointed by the N.F.P.A.

The National Electrical Code is a collection of rules governing the installation, and, to a certain extent, the use of electrical equipment. Its purpose is to reduce the hazard from electrical fires and electrical accidents and it does this by specifying the exact manner in which electrical materials, devices, fittings and appliances shall be both originally installed and later maintained. A strict compliance with the National Electrical Code will produce an electrical installation which may be deemed reasonably safe from electrical fires or accidents. Without a doubt there is no similar instrument in existence which can even approach the application of the N.F.P.A. National Electrical Code. It is also undoubtedly true that no similar instrument receives quite so loyal support as that bestowed upon the N.F.P.A. National Electrical Code by those who are called upon to enforce it or comply with its provisions. It is indeed unusual to find an electrician, manufacturer or electrical inspector on a job without a copy of the National Electrical Code in his hand or sticking out of his pocket.

The work of the N.F.P.A. Electrical Committee is carried on by what are termed "Article Committees," each article or chapter of the National Electrical Code being assigned to a committee. Suggestions for Code revisions are referred to the appropriate Article Committee.

If the Electrical or Article Committee believes that a subject before it is such as will require technical study by experts other than those within its membership, the Article Committee or the Electrical Committee may request the Chairman of the Electrical Committee to appoint a Technical Sub-Committee to study the inventor's product. This Technical Sub-

Electrical Committee Officers and Article Chairmen.

(Left) Alvah Small, chairman of the N.F.P.A. Electrical Committee. Mr. Small is president of the Underwriters' Laboratories, Inc., was president of the N.F.P.A. from 1940-1942; served as a member of the N.F.P.A. Board of Directors for many years. He was made an Honorary Life Member in 1944.

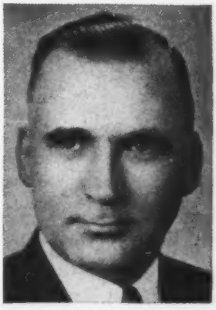
(Right) Victor H. Tousley, secretary of the Electrical Committee. Mr. Tousley is secretary-treasurer of the International Association of Electrical Inspectors and N.F.P.A. Electrical Field Engineer.

(Left) L. F. Adams, Arts. 610, 615, 710. Mr. Adams is manager, Standards Division, Executive Dept., General Electric Co., and is vice-president of the U. S. National Electrochemical Commission.

(Center) K. W. Adkins, Arts. 334, 336, 338, 340. Mr. Adkins is chief fire protection engineer, Missouri Inspection Bureau. He is a past president of the International Association of Electrical Inspectors.

(Right) Merwin M. Brandon, Arts. 600, 720. Mr. Brandon is electrical engineer, Underwriters' Laboratories, Inc., New York.

(Left) O. K. Coleman, Art. 230. Mr. Coleman, now an electrical consultant, was formerly assistant to the vice-president and chief engineer of the American Gas and Electric Service Corporation.

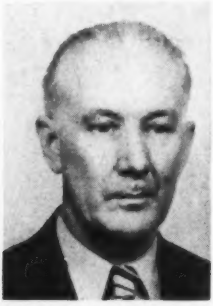


(Right) L. P. Dendel, Arts. 300, 370, 620. Mr. Dendel is assistant secretary of public relations, Michigan Millers Mutual Fire Insurance Company and a past president of the International Association of Electrical Inspectors.

(Left) L. W. Going, Arts. 362, 364, 422. Mr. Going is chief electrical inspector of the City of Portland, Oregon, and a past president of the International Association of Electrical Inspectors.

(Center) A. P. Good, Arts. 346, 348, 350, 352, 354 and 356. Mr. Good is superintendent of the Meter Dept. of Commonwealth Edison of Chicago and a former member of the Electrical Commission of the City of Chicago.

(Right) S. B. Graham, Arts. 640, 810. Mr. Graham is in the General Engineering Department, American Telephone & Telegraph Company, New York.



(Left) W. A. Haig, Arts. 410, 420. Chief electrical inspector, City of Milwaukee, Wis., and past president, International Association of Electrical Inspectors (Western Section).

(Right) Carlton L. Kennedy, Arts, 430, 445 and 670. Formerly vice-president in charge of engineering Holtzer-Cabot Division of First Industrial Corp.

(Left) J. D. Lynett Arts. 373, 374, 380, 384. Mr. Lynett is superintendent of the Bureau of Electricity, New York Board of Fire Underwriters, and a former President of International Association of Electrical Inspectors.

(Center) L. W. McCullough, Arts. 450, 460, 470. Mr. McCullough is general engineer, Consolidated Edison Company of New York.

(Right) H. N. Pye, Arts. 210, 220. Mr. Pye is chief engineer, Engineering Department, South-Eastern Underwriters Association.

(Left) W. R. Rilling, Arts. 342 and 358 (New 344). Mr. Rilling is in charge of the Chicago Office, Division of the Electrical Department of Underwriters' Laboratories, Inc.

(Center) A. H. Schirmer, Art. 250. Mr. Schirmer is protection engineer in the Transmission Engineering Department of Bell Telephone Laboratories, New York.

(Right) Robert B. Shepard, Art. 400. Mr. Shepard, who was chief electrical engineer, Underwriters' Laboratories, Inc., New York, passed away June 20, 1946. He was one of the most devoted members of the Electrical Committee.

(Left) Frank Thornton, Jr., Arts. 100, 110. Mr. Thornton is engineering manager, Association Activities, Westinghouse Electric Corporation.

(Right) E. E. Turkington, Art. 240. Mr. Turkington is chief electrical engineer of the Associated Factory Mutual Fire Insurance Companies.

(Left) L. A. Vincent, Art. 700 and Com. on Chap. 9. Mr. Vincent is assistant to the general manager of the National Board of Fire Underwriters.

(Center) Ralph Wiley, Art. 280 Com. Mr. Wiley is chief of the Department of Electricity of the County of San Francisco and is a past president of the International Assn. of Electrical Inspectors.

(Right) J. E. Wise, Arts. 200, 730. Mr. Wise is electrical engineer with the Industrial Commission of Wisconsin.

Committee after completing its investigation, reports to the Article Committee the result of its findings, making recommendations only when requested by the Article Committee. Article Committees must report to the Chairman of the Electrical Committee not less than six months in advance of the code-revision meeting and all reports endorsed by the Article Committees are published for the information of the electrical public about four months in advance of the code-revision meeting.

At the Electrical Committee meetings the reports of the Article Committees are discussed and after sessions lasting as much as five full days a new edition of the National Electrical Code is completed. This is subsequently submitted to the N.F.P.A. annual meeting for adoption by the Association as sponsor for the Code. The final text is then submitted to the American Standards Association for approval as an American Standard. Successive editions, issued in normal times at two or three-year intervals, have been published by the National Board of Fire Underwriters and distributed in editions of hundreds of thousands of copies.

Like other standards of the N.F.P.A., the National Electrical Code is purely advisory as far as the Association is concerned, but is widely adopted as law or as the basis of regulations issued by administrative authorities having the force and effect of law.

No law or legal regulation, no matter how perfect in itself, can be effective in the absence of public acceptance and competent enforcement. The National Electrical Code is universally accepted and is enforced, in general, with an efficiency that is equaled in few other fields. The electrical inspectors of the United States and Canada are a fine group of public servants largely devoting their lives to protecting the public through enforcement of the Electrical Code. The electrical inspectors have an international association, an organization member of the N.F.P.A., which through local group discussions and representation on the N.F.P.A. Electrical Committee plays a very important rôle in the development of successive editions of the Code.

The national uniformity in electrical installation brought about by the general observance of the National Electrical Code has been of great benefit to all concerned. Manufacturers of new electrical materials or equipment, after having secured recognition in the National Electrical Code, are assured that the installation of their equipment will be permitted. If, on the other hand, states or municipalities did not automatically adopt the Code, the manufacturer of any new device or material must convince the local officials in every jurisdiction before he can sell his product. Furthermore, and perhaps of even more importance, with differing requirements in different states and cities, manufacturers would be confronted with the necessity of making a great variety of special products to comply with individual local requirements, with consequent loss of the savings in cost due to large quantity production of individual items. Thus the general application of the Code provides not only greatly increased safety to the public, but is of great benefit to the manufacturer and installer of electrical equipment and through the advantages of quantity production provides a real saving in the cost of electrical installations.

The current personnel of the committee is given in the 1946 Year Book, which was published as Part 2 of the October, 1946, QUARTERLY. The pictures of men participating in the Electrical Committee work, reproduced with this article, are

those of the chairmen of various article subcommittees. Many others are equally deserving of recognition on the basis of their contributions to successive editions of the Code, but the lack of suitable photographs as well as space limitations prevents the inclusion of additional photograhs in this article.

(1) Dear Sir:

Mr. F. E. Cabot, of the Boston Board of Underwriters, and myself, after talking over the matter, have thought it might be an advantage to the various Underwriters' Associations in connection with the matter of electrical rules and inspections, if the various inspectors would meet together and discuss the subject.

Will you kindly advise me if it would be probable that you would attend a meeting, say in the vicinity of New York City some time this summer?

I would be pleased if you would make any suggestions as to the time and place of the meeting. Also, if you would suggest any inspectors whom you would desire invited in addition to the following list:

W. A. Anderson of the New York Board of Fire Underwriters; Wm. McDevitt of the Philadelphia Board; A. E. Bradell of the Middle Dept.; J. W. Churchill of the Southeastern Tariff Assn.; H. G. Balkam of the Baltimore Assn.; Rob't H. McMath of the St. Louis Board; Frank Kitton of the Buffalo Assn.; E. A. Fitzgerald of the New York State Assn.; and F. E. Cabot of the Boston Board.

Yours very truly,

C. M. Goddard.

(2) Members of the original "Electrical Committee" elected at the meeting in New York City on December 6, 1892, at which meeting the Underwriters' National Electrical Association was organized, were:

F. E. Cabot, Chairman, Boston Board of Fire Underwriters.

C. M. Goddard, Secretary, New England Insurance Exchange.

W. A. Anderson, New York Board of Fire Underwriters.

C. E. Bliven, The "Union" and Chicago Board.

E. A. Fitzgerald, Underwriters' Assn. of N. Y. State.

George P. Low, Pacific Insurance Union.

Edward Leloup, Southeastern Tariff Assn.

Wm. McDevitt, Philadelphia Fire Underwriters' Assn.

A. E. Van Geisen, New York Board of Fire Underwriters.

Fires and Fire Losses Classified, 1945.

In selecting data for use in the 1945 loss tables a slight deviation has been made from the method used in other years. In the past only data of those states having losses classified both by cause and by occupancy were tabulated. Such a procedure severely reduced the number of state reports that could be accepted and consequently limited the experience needed for computing the national loss. Therefore, in order to make use of all possible data, states reporting losses and number of fires either by cause or by occupancy were used. With this variation the number of states represented includes approximately 30 per cent of the United States population.

About half of the states make no attempt whatever to classify losses either by cause or occupancy. It is the conviction of the National Fire Protection Association's Executive Office that through continual study of carefully tabulated fire loss data a state can identify its most serious fire hazards and take proper steps to protect the life and property of its citizens. This compilation of fourteen typical states is intended to indicate fire experience trends in the nation.

Tables I to IV are tabulations from Fire Marshals' reports for 1945 or for the nearest fiscal year. Table I shows the number of fires by occupancy in thirteen states and Table II the loss by occupancy in fourteen states. Tables III and IV list the number of fires and loss in the selected states by cause. The cause "Oil Burners" was removed from the classification this year, as most of the states report such fires under "Flammable Liquids, Miscellaneous" or under "Defective or Overheated Heating Equipment", making it impossible to classify properly fires from oil burners. "Fireworks" was also removed because the effectiveness of the model N.F.P.A. fireworks law in most of the states reporting has all but eliminated this hazard in a large part of the country.

In general these tables do not include

Table I. Number of Fires by Occupancies in Thirteen States — 1945.

Occupancy	Conn.[1]	Illinois	Indiana[2]	Iowa	Kansas	Louisiana	Massachusetts	Nebraska	New Hamp.	Ohio	Oregon[2]	Vermont	West Virginia[4]	Total
I. Public Buildings														
Government buildings	10	....	15	....	1	....	30	3	32	....	19	3	....	113
Hospitals, institutions	....	54	7	3	8*a*	16*a*	24	2	....	24	....	2	2	142
Schools and colleges	18	....	19	20	12	24	39	11	9	38	34	8	6	238
Churches	8	71	25	13	8	18	17	12	3	99	15	6	2	297
Theatres, including motion pictures	4	42	6	10	8	17	8	14	....	33	22	2	10	176
Amusements, halls	20	55	13	10	....	....	79	....	....	90	....	6	11	284
II. Dwellings														
Hotels, boarding houses	16	168	61	44	15*b*	53*b*	223	21*b*	15	217	380	6	13	1,232
Apartments, rooming houses	213	2,172	97	183	....	....	....	22	77	1,924	....	....	17	4,705
Dwellings	1,224	4,870	2,483	1,909	1,217*c*	2,029	5,340*h*	830	610	10,115	6,291*h*	829	315	38,062
III. Mercantile														
Office buildings, including banks	19	144	25	52	....	155	86	21	....	206	....	4	4	716
Restaurants, taverns	....	318	80	93	....	....	102	45	19	....	123	11	4	795
Miscellaneous mercantiles	149	1,213	48	169	492	176	534	130	66	1,266	560*i*	120	55	4,978
Warehouses	21	110	57	69	....	31	178	22	13	387	67*j*	6	15	976
IV. Manufacturing														
Metal workers	5	27	7	21	1	7	45	1	....	....	44	5	....	163
Woodworkers	3	4	....	....	1	27	127	....	....	....	....	7	....	169
Flour mills, elevators	....	52	7	48	10*d*	7	....	13	....	....	29	1	....	167
Packing plants	....	15	....	11	....	....	....	1	....	....	25	....	1	53
Bakeries	....	....	7	8	....	....	9	....	....	....	15	1	....	40
Laundries	9	42	17	9	12*e*	31*e*	27	6	2	62	22*e*	2	10*e*	251
Cleaners, tailors	10	62	13	12	....	....	24	4	....	36	....	1	....	162
Misc. manufacturing	97	425	122	58	10	123	397	29	61	996	64	22	14	2,418
V. Miscellaneous														
Barns	169	397	58	179	....	....	182	141	67	502	369*c*	....	23	2,087
Outbuildings	5	783	420	242	....	....	121	130	....	529	....	1	12	2,243
Lumber and coal yards	9	....	12	5	5	11	19	4	....	10	199*k*	....	7	281
Railroad, wharf property	....	36	19	17	4*f*	13*f*	3	7	....	....	....	1	2	102
Bulk oil storage, refineries	....	17	....	31	....	49	19	3	....	....	22	....	....	141
Garages, filling stations	169	973	300	241	53*g*	20*g*	247	173	23	1,327	38	19	37	3,597
Power plants, pump houses	....	11	21	2	2	....	2	....	....	....	27	....	1	66
Creameries and dairies	....	....	6	11	....	....	....	7	....	....	8	6	1	62
Miscellaneous structures	69	357	430	149	15	68	139	5	....	1,866	53	2	14	3,167
Motor vehicles	144	1,466	293	462	279	137	872	155	....	3,911	365	....	29	8,113
Fires other than buildings	10	213	619	112	213	133	23	94	19	391	1	....	14	1,842
Hangars and contents	....	....	....	....	....	....	....	1	....	....	....	....	....	1
Total	2,401	14,097	5,287	4,193	2,366*	3,145	8,916	1,907	1,016	24,029	8,792	1,071	619	77,839

*Duplicate 158 fires—total number 2,088.
[1]Fiscal year ending June 30, 1945.
[2]Fiscal year ending June 30, 1945.
[3]Number of insurance claims, not number of fires.
[4]Does not includes fires with damage less than fifty dollars.

a. Includes government buildings.
b. Includes amusements, halls.
c. Includes outbuildings.
d. Includes warehouses.
e. Includes cleaners, tailors.
f. Includes power plants, pump houses.
g. Includes hangars and contents.
h. Includes miscellaneous mercantiles.
i. Includes office buildings and banks.
j. Includes railroad, wharf property.
k. Includes woodworkers.

Table II. Fire Losses by Occupancies in Fourteen States — 1945.

Occupancy	Conn.[3]	Illinois[1]	Indiana[4]	Iowa	Kansas	Louisiana	Massachusetts	Nebraska	New Hamp.	Ohio	Oregon[2]	Texas	Vermont	West Virginia[3]	Total
I. Public Buildings															
Government buildings	$20,871	....	$23,610	....	$238,594	....	$173,638	$155	$45.833	....	$11,502	$26,882	$10,440	....	$551,525
Hospitals, institutions	....	$475,952	1,452	$425	3,026	$186,851*a*	3,087	452	....	$13,023	....	11,332	856	$9,800	706,256
Schools and colleges	122,680	....	403,925	28,644	108,947	166,778	517,244	68,515	14,175	132,246	225,070	486,612	82,979	16,110	2,373,925
Churches	118,655	283,884	41,935	38,726	1,128	95,788	95,763	21,273	3,476	67,874	33,678	187,102	7,025	47,500	1,043,807
Theatres, including motion pictures	410	226,219	12,800	152,485	8,824	....	98,786	164,120	....	63,690	25,292	200,929	12,808	515,749	1,482,112
Amusements, halls	97,632	186,695	184,486	34,370	....	....	189,678	....	....	247,783	....	48,402	8,068	122,448	1,119,562
II. Dwellings															
Hotels, boarding houses	69,432	169,005	119,048	107,640	11,114*b*	85,979*b*	395,407	5,005*b*	43,757	320,041	69,172	125,161	6,646	220,120	1,747,527
Apartments, rooming houses	225,576	226,599	78,716	192,317	....	....	....	31,426	59,245	649,517	....	269,880	....	66,221	1,799,497
Dwellings	1,558,551	2,873,396	1,798,373	1,401,576	380,687*c*	1,471,425	5,766,666*h*	522,433	427,342	3.506,675	1,955,638*h*	4,588,058	1,087,182	519,942	27,857,944
III. Mercantile															
Office buildings, including banks	33,380	67,830	177,742	72,748	....	488,010	595,144	33,212	....	249,410	....	....	5,038	342,214	2,064,728
Restaurants, taverns	103,907	508,750	102,674	32,761	....	....	213,243	85,037	31,884	....	129,798	....	24,778	16,175	1,249,007
Miscellaneous mercantiles	271,781	1,973,958	146,892	578,229	795,858	385,588	1,464,255	615,855	301,941	2,337,168	984,417*i*	4,235,707	396,643	450,847	14,939,139
Warehouses	57,440	912,156	300,302	227,823	....	44,139	751,700	142,157	21,681	1,423,832	107,694*j*	1,058,095	3,776	70,149	5,120,944
IV. Manufacturing															
Metal workers	8,475	21,585	67,520	23,730	10,000	144,872	138,063	130	....	....	406,764	278,008	24,622	....	1,123,769
Woodworkers	8,400	48,135	....	....	....	275,291	93,944	....	....	....	....	70,596	75,311	....	571,677
Flour mills, elevators	....	425,814	130,275	318,276	210,909*d*	1,079	....	60,138	....	....	389,933	138,971	254	....	1,675,649
Packing plants	....	5,570	....	55,326	....	....	....	10	....	....	114,723	34,857	....	53,000	263,486
Bakeries	....	....	1,570	4,637	....	....	29,603	....	....	....	54,030	120,254	72,822	....	282,916
Laundries	9,734	16,747	16,305	7,344	32,876*c*	53,160*c*	50,284	5,936	12,033	44,672	13,521*c*	38,317	3,922	73,783*c*	378,637
Cleaners, tailors	1,986	20,484	3,187	3,487	....	....	176,754	1,548	....	38,945	....	....	55	....	246,446
Misc. manufacturing	709,747	1,533,712	1,268,215	457,026	297,769	613,053	2,145,417	610,181	166,630	2,848,833	747,513	2,029,541	73,538	346,525	13,787,702
V. Miscellaneous															
Barns	455,535	1,128,420	97,829	474,911	....	....	665,470	185,635	92,984	823,062	354,089*c*	1,328	....	51,569	4,330,822
Outbuildings	14,550	150,887	942,113	90,363	20	....	47,868	40,319	....	149,434	....	....	4,159	9,650	1,449,363
Lumber and coal yards	105,720	....	51,767	48,677	33,240	29,340	297,706	24,747	....	56,294	2,782,079*k*	57,085	....	59,000	3,545,655
Railroad, wharf property	....	12,185	523,769	16,569	35*f*	96,045*f*	6,366	2,660	....	....	....	21,129	10,346	13,120	702,224
Bulk oil storage, refineries	....	30,697	....	60,597	....	208,918	25,549	3,730	....	....	12,696	880,434	....	....	1,222,621
Garages, filling stations	157,191	438,599	378,644	213,583	670,476*a*	34,059*g*	366,071	137,564	36,527	544,127	70,473	254,563	23,158	69,602	3,394,637
Power plants, pump houses	....	25,135	30,536	3,115	5,640	....	5,015	....	....	....	29,389	5,750	....	15,000	119,580
Creameries and dairies	....	....	30,630	78,109	....	....	....	59,524	....	....	14,967	....	110,805	650	294,685
Miscellaneous structures	154,193	471,742	1,319,784	158,055	50,345	245,204	561,510	41,870	....	2,172,915	274,230	706,872	5,325	30,930	6,192,975
Motor vehicles	53,772	148,982	112,341	47,210	28,195	48,695	138,669	37,654	....	255,134	66,835	....	....	31,792	969,279
Fires other than buildings	7,677	70,001	86,644	9,304	269,250	307,713	67,081	38,627	8,520	7,014	29,024	270,767	....	302,850	1,474,472
Hangars and contents	....	....	....	....	....	....	....	77	....	....	....	....	....	....	77
Total	$4,367,295	$12,453,139	$8,453,084	$4,938,063	$3,156,933	$4,981,989	$15,079,981	$2,939,990	$1,206,028	$15,951,679	$8,902,530	$16,146,632	$2,050,556	$3,454,746	$104,082,645

[1] Does not include Chicago losses.
[2] Insurance losses only.
[3] Fiscal year ending June 30, 1945.
[4] Fiscal year ending June 30, 1945.
[5] Does not include fires with damage less than fifty dollars.

a. Includes government buildings.
b. Includes amusements, halls.
c. Includes outbuildings.
d. Includes warehouses.
e. Includes cleaners, tailors.
f. Includes power plants, pump houses.
g. Includes hangars and contents.
h. Includes miscellaneous mercantiles.
i. Includes office buildings and banks.
j. Includes railroad, wharf property.
k. Includes woodworkers.

Table III. Number of Fires by Causes in Thirteen States — 1945.

Causes	Conn.[3]	Illinois	Indiana[3]	Iowa	Kansas	Louisiana	Massa-chusetts	Nebraska	New Hamp.	Ohio	Oregon[3]	Vermont	West Virginia[4]	Total
Chimneys, flues—defective or overheated	235	970	351	807	114	67	586	78	298	1,561	559	128	34	5,788
Sparks on roofs	....	854	404	....	110	27	....	....	....	1,863	537	7	....	3,802
Defective or overheated heating equipment	97	1,417	114	411	253	309	291	114	51	2,300	1,082	80	42	6,561
Rubbish	129	1,246	220	204	22	27	....	151	43	864	44	10	11	2,971
Combustibles near heaters	3	102	21	27	10	32	269	....	8	....	....	2	16	490
Open lights, flames, sparks	38	256	....	16	58	53	445	155	20	575	163	12	11	1,802
Hot ashes, coals	32	244	240	45	126	35	130	39	51	360	395	20	3	1,720
Smoking and matches	411	2,326	425	390	244	457	2,548	271	101	4,399	1,840	92	33	13,537
Children and matches	84	....	....	140	....	....	497	....	....	1,014	....	....	13	1,748
Electrical, fixed service; fires due to misuse, or faulty wiring and equipment	230	155	295	368	282	240	907	245*b*	98	3,192	629	68	56	6,765
Electrical power consuming appliances	112	2,221	77	153	20	60	479	....	....	867	296*c*	6	14	4,305
Flammable liquids, misc., including home dry cleaning and starting fires with	215	875	58	107	99	175	1,244	76	10	965	134	107	6	4,071
Torches, welding, cutting, plumbers, etc.	17	....	20	33	....	....	73	23	11	147	....	....	2	326
Lamps, lanterns, and stoves	106	....	424	93	....	....	....	56	110	....	....	....	3	792
Gas and appliances	....	86	2	131	38	74	11	....	....	283	....	3	8	636
Grease, tar, etc.	30	206	....	38	42	61	165	....	8	314	538	15	5	1,422
Spontaneous ignition	67	352	193	95	41	31	414	80	23	552	89	25	10	1,972
Lightning	47	313	78	98	48	108	101	51	26	217	17	85	18	1,207
Thawing pipes	7	....	13	13	....	....	49	....	2	....	....	....	2	86
Sparks from machinery, friction	20	35	8	33	13	61	16	23	....	....	46	....	....	255
Incendiary, suspicious	38	43	14	28	9	10	172	14	3	217	28	8	19	603
Miscellaneous	189	464	126	178	80	53	17	16	13	2,281	20	27	16	3,480
Unknown	224	1,292	1,993	587	549	928	475	227	136	1,491	1,880	261	225	10,268
Explosions	29	132	162	....	52	30	27	62	4	....	151*d*	3	25	677
Exposure	41	508	49	198	156	307	270*a*	226	....	567	344	112	47	2,555
Total	2,401	14,097	5,287	4,193	2,366*	3,145	8,916	1,907	1,016	24,029	8,792	1,071	619	77,839

*Duplicate 158 fires—total number 2,088.
[1]Fiscal year ending June 30, 1945.
[2]Fiscal year ending June 30, 1945.
[3]Includes insurance loss.
[4]Does not include fires with damage less than fifty dollars.
a. Exposures not included in grand total.
b. Includes electrical power consuming appliances.
c. Includes other hot metals.
d. Includes open lights, flames, sparks.

Table IV. Fire Loss by Causes in Twelve States — 1945.

Causes	Conn.[1]	Illinois[2]	Indiana[3]	Iowa	Kansas	Louisiana	Massachusetts	Nebraska	Ohio	Oregon[4]	Vermont	West Virginia[5]	Total
Chimneys, flues—defective or overheated	$410,191	$425,752	$293,440	$410,626	$46,339	$62,227	$651,415	$86,116	$630,122	$246,372	$122,065	$78,672	$3,463,337
Sparks on roofs	....	269,087	233,812	....	16,349	41,879	....	....	621,489	461,267	5,528	....	1,649,411
Defective or overheated heating equipment	145,088	970,680	115,250	425,450	98,402	269,015	387,744	145,374	1,688,617	417,857	84,136	86,149	4,833,762
Rubbish	127,227	112,606	104,112	57,999	14,330	60,267	....	45,704	243,560	20,451	4,982	7,924	799,162
Combustibles near heaters	3,431	32,527	4,028	21,908	16,243	294,561	396,069	....	....	....	352	10,463	779,582
Open lights, flames, sparks	51,660	176,131	....	6,562	13,169	221,264	444,364	465,031	305,284	33,614	26,037	221,400	1,964,516
Hot ashes, coals	32,012	69,797	185,565	26,412	81,116	21,333	170,356	14,340	157,218	48,847	30,163	9,400	846,559
Smoking and matches	466,454	440,535	173,784	93,578	53,271	286,827	3,276,300	102,169	1,307,000	305,779	48,021	24,593	6,578,311
Children and matches	132,677	....	....	35,453	....	....	435,917	....	214,020	....	....	8,760	826,827
Electrical, fixed service; fires due to misuse, or faulty wiring and equipment	339,470	33,514	537,315	288,485	649,916	417,553	2,229,587	530,299*b*	1,464,476	412,456	97,140	103,543	7,103,754
Electrical power consuming appliances	78,031	1,657,924	262,856	190,258	5,843	76,240	228,245	....	208,452	50,808*c*	1,380	67,530	2,827,567
Flammable liquids, misc., including home dry cleaning and starting fires with	293,368	684,263	37,201	101,058	74,398	241,886	1,414,755	106,880	369,533	53,068	120,929	4,809	3,502,148
Torches, welding, cutting, plumbers, etc.	16,287	....	60,618	21,455	....	....	123,040	12,934	160,058	....	....	2,425	396,817
Lamps, lanterns, and stoves	127,777	....	579,162	35,906	....	....	....	21,449	....	....	....	700	764,994
Gas and appliances	....	51,523	2,625	19,716	28,909	47,218	23,660	....	497,586	....	5,260	31,200	707,697
Grease, tar, etc.	25,538	147,251	....	18,063	14,528	42,832	187,361	....	261,467	110,995	13,648	3,497	825,180
Spontaneous ignition	149,261	705,702	980,062	225,975	40,588	77,180	1,029,391	172,751	930,749	442,904	58,742	14,675	4,827,980
Lightning	121,688	591,875	212,780	203,867	61,710	85,681	217,795	47,581	199,099	25,816	109,707	40,700	1,918,299
Thawing pipes	16,142	....	7,559	....	....	....	33,820	....	....	....	....	3,700	61,221
Sparks from machinery, friction	10,452	25,700	2,210	32,189	6,105	86,303	22,090	13,719	....	161,361	....	....	360,129
Incendiary, suspicious	48,167	26,823	45,731	18,557	5,358	12,184	524,388	6,501	213,958	101,684	43,182	107,335	1,153,868
Miscellaneous	575,045	108,619	46,217	72,688	28,202	34,889	31,132	2,945	1,057,790	8,642	35,195	75,813	2,077,177
Unknown	1,021,830	5,148,501	4,212,234	2,320,792	1,512,011	2,200,757	3,185,369	624,221	4,856,210	4,923,147	955,930	2,053,041	33,014,043
Explosions	33,289	156,467	272,883	....	294,588	132,342	67,241	412,703	....	702,569*d*	504	288,357	2,360,943
Exposure	142,210	617,862	84,815	311,066	95,558	269,551	255,736*a*	136,953	564,991	374,892	287,655	210,059	3,095,612
Total	$4,367,295	$12,453,139	$8,454,259	$4,938,063	$3,156,933	$4,981,989	$15,080,039	$2,947,670	$15,951,679	$8,902,529	$2,050,556	$3,454,745	$86,738,896

[1]Fiscal year ends June 30, 1945.
[2]Does not include Chicago losses.
[3]Fiscal year ends June 30, 1945.
[4]Includes insurance loss.
[5]Does not include fires with damage less than fifty dollars.
a. Exposures not included in grand total.
b. Includes electrical power consuming appliances.
c. Includes other hot metals.
d. Includes open lights, flames, sparks.

forest fire losses, damage to airplanes that burn outside of hangars, or damage to ships.

Tables V to VII are recapitulations and estimates for the entire United States based on the four preceding tables. (Certain percentages are added to cover unreported fires and losses as explained below.) In a few instances adjustment had to be made to the national estimate to prevent distortion of any one occupancy or cause by one unusually serious fire in a given class.

As will be seen in Table V, the thirteen states with a population of 36,120,035 reported a total of 77,839 fires. Experience indicates that this is about half the actual number of fires. Many states, for example, do not report fires with loss less than $25 or $50. To obtain a more accurate estimate of the number of fires in these thirteen states, therefore, 100 per cent is added. Making use of this figure and the population ratio, the number of fires for the nation is calculated. The estimated number of fires for 1945 is 585,000 as compared with 600,000 in 1944, or 4.44 per thousand as compared with 4.58 in 1944.

To obtain the estimated national fire loss the population ratio was applied to the loss of the thirteen reporting states. To

Table V. Fires per 1000 Population and Fire Loss per Person for Thirteen States, 1945, as Reported by Fire Marshals.

State	Population 1940 Census	Number of Fires	Fires per 1000 Pop.	Fire Loss	Fire Loss per Person
Connecticut	1,709,242	2,401	1.405	$4,367,295[2]	$2.56
Illinois	7,897,241	14,097	1.785	12,453,139[1]	2.77
Indiana	3,427,796	5,288	1.543	8,454,223[2]	2.47
Iowa	2,538,268	4,193	1.652	4,938,063	1.95
Kansas	1,801,028	2,088	1.159	2,188,458	1.22
Louisiana	2,363,880	3,145	1.330	4,981,989	2.11
Massachusetts	4,316,721	8,196	1.898	15,080,039	3.49
Nebraska	1,315,834	1,907	1.450	2,947,670	2.24
New Hampshire	491,524	1,016	2.067	1,206,028	2.45
Ohio	6,907,612	24,029	3.450	15,951,679	2.31
Oregon	1,089,684	8,792[3]	8.066[3]	8,902,529	8.17
Vermont	359,231	1,071	2.983	2,050,556	5.71
West Virginia	1,901,974	619	.325	3,454,745[4]	1.81
Total	36,120,035	77,839	2.15	$104,082,645	$2.88
Estimated U. S. Total	131,669,275	585,000	4.44	485,000,000	3.91

[1]Chicago losses or population not included. [3]Fiscal year ending June 30, 1945.
[2]Includes total insurance claims. [4]Does not include fires with damages less than fifty dollars.

States Reporting Partial Data (Not Included in Tabulations)

	Population	Number of Fires	Fire Loss	Fire Loss per Person
Alabama	2,832,961	.....	$4,593,164	$1.62
Kentucky[1]	2,845,627	13,266	5,265,644	1.85
Michigan	5,256,106	49,167	19,549,707	3.72
Montana	559,456	819	848,286	1.52
Rhode Island[2]	713,346	1,567	2,280,289	3.20
Tennessee	2,915,841	.....	5,897,685[3]	2.02
Washington	1,736,191	.....	5,903,726[3]	3.40
Wisconsin	3,137,587	18,369	8,617,315	2.75

[1]Fiscal year ending June 30, 1946. [2]Fiscal year ending September 30, 1945. [3]Insured losses only.

Table VI. Estimated Distribution of U. S. Fire Losses by Occupancies, 1945.

These estimated figures are intended to show the relative order of magnitude of fire losses by occupancies, and while they are reasonable approximations based on the experience in typical states they should not be taken as exact records for each class.

Occupancy	No. of Fires	Loss
I. PUBLIC BUILDINGS		
Government buildings	2,000	$15,000,000
Hospitals, institutions	1,000	2,600,000
Schools and colleges	2,200	9,000,000
Churches	2,100	3,500,000
Theatres, including motion pictures	1,300	5,400,000
Amusements, halls	2,600	4,600,000
II. DWELLINGS		
Hotels, boarding houses	8,800	5,900,000
Apartments, rooming houses	47,200	8,100,000
Dwellings	276,000	94,000,000
III. MERCANTILE		
Office buildings, including banks	5,600	9,100,000
Restaurants, taverns	7,900	7,600,000
Miscellaneous mercantiles	37,200	50,200,000
Warehouses	7,500	48,100,000
IV. MANUFACTURING		
Metal workers	1,600	15,700,000
Woodworkers	2,300	3,800,000
Flour mills, elevators	2,000	13,000,000
Packing plants	1,000	1,900,000
Bakeries	1,000	2,000,000
Laundries	1,800	1,200,000
Cleaners, tailors	1,500	1,300,000
Miscellaneous manufacturing	17,300	46,500,000
V. MISCELLANEOUS		
Barns	16,600	16,500,000
Outbuildings	19,500	6,600,000
Lumber and coal yards	2,600	14,000,000
Piers, including shipyards	1,100	11,100,000
Railroad property	5,200	7,000,000
Bulk oil storage, refineries	1,800	7,100,000
Garages, filling stations	26,000	1,500,000
Power plants, pump houses	800	600,000
Creameries and dairies	1,600	3,700,000
Miscellaneous structures	10,300	21,100,000
Motor vehicles	56,000	3,300,000
Fires other than buildings	13,300	5,000,000
Hangars and contents	300	*39,000,000
Totals	585,000	$485,000,000

NOTE: As explained in the text, 100 per cent has been added in estimating the number of fires, and 33⅓ per cent has been added to the losses to cover unreported losses.

Railroad losses have been separated from pier, wharf property fire losses reported by State Fire Marshals. Railroad losses from Association of American Railroads report.

*Includes $30,000,000 for fire at Richmond Naval Air Station, Florida.

account for large unreported losses in government property and other losses not reported through usual channels, 33⅓ per cent was added. The 1945 estimated loss is $485,000,000 as compared with $456,000,000 in 1944.

The fire loss tables for 1945 show a continuance of the trend of the last few years of a reduction in the number of fires and an increase in the amount of loss. The fire consciousness of the nation during the war years is undoubtedly the primary reason for the reduction in the number of fires. Also having a bearing is the fact that burned property can be replaced only with difficulty. In regard to the increase in loss the excessive amount of property subject to a single fire in many war industries was

Table VII. Estimated Distribution of U. S. Fire Losses by Causes, 1945.

These estimated figures are intended to show the relative order of magnitude of fire losses by causes, and while they are reasonable approximations based on the experience in typical states they should not be taken as exact records for each class.

	No. of Fires	Loss
Chimneys, flues—defective or overheated	40,000	$17,500,000
Sparks on roofs	39,000	15,500,000
Defective or overheated heating equipment	45,000	25,000,000
Rubbish	18,000	5,000,000
Combustibles near heaters	5,000	5,500,000
Open lights, flames, sparks	14,000	11,000,000
Hot ashes, coals	12,000	4,500,000
Smoking and matches	93,000	38,000,000
Children and matches	26,000	4,500,000
Electrical, fixed services; fires due to misuse, or faulty wiring and equipment	47,000	36,000,000
Electrical power consuming appliances	31,000	15,000,000
Flammable liquids, misc., including home dry cleaning and starting fires with	28,000	16,000,000
Torches, welding, cutting, plumbers, etc.	4,000	3,200,000
Lamps, lanterns, stoves	18,000	14,000,000
Gas and appliances	5,000	4,500,000
Grease, tar, etc.	11,000	5,000,000
Spontaneous ignition	14,000	25,000,000
Lightning	9,000	10,000,000
Thawing pipes	1,500	1,100,000
Sparks from machinery, friction	2,500	3,200,000
Incendiary, suspicious	4,000	6,500,000
Miscellaneous	24,000	11,000,000
Unknown	70,000	171,000,000
Explosions	6,000	21,000,000
Exposure	18,000	16,000,000
Totals	585,000	$485,000,000

NOTE: As explained in the text, 100 per cent has been added in estimating the number of fires, and 33⅓ per cent has been added to the losses to cover unreported losses.

Table VIII. Five-Year Average Estimated U. S. Fire Losses by Occupancies (1941-1945).

Occupancy	Average No. of Losses	Average Amount of Loss
I. PUBLIC BUILDINGS		
Government buildings	1,000	$13,450,000
Hospitals, institutions	1,000	2,370,000
Schools and colleges	2,000	7,500,000
Churches	2,500	4,800,000
Theatres, including motion pictures	1,500	3,450,000
Amusements, halls	2,500	3,890,000
II. DWELLINGS		
Hotels, boarding houses	10,000	4,860,000
Apartments, rooming houses	45,800	6,460,000
Dwellings	311,500	92,300,000
III. MERCANTILE		
Office buildings, including banks	6,000	8,660,000
Restaurants, taverns	10,000	7,800,000
Barber shops	1,000	23,000
Miscellaneous mercantiles	40,000	42,240,000
Warehouses	7,000	24,320,000
IV. MANUFACTURING		
Metal workers	1,800	6,340,000
Woodworkers	2,000	7,760,000
Flour mills, elevators	2,300	11,700,000
Packing plants	800	1,640,000
Bakeries	1,000	1,040,000
Laundries	1,900	1,520,000
Cleaners, tailors	1,000	1,060,000
Miscellaneous manufacturing	18,000	48,100,000
V. MISCELLANEOUS		
Barns	22,500	20,860,000
Outbuildings	21,500	5,150,000
Lumber and coal yards	2,000	7,700,000
Piers, including shipyards	2,500	7,600,000
Railroad property	5,000	8,300,000
Bulk oil storage, refineries	1,500	4,080,000
Garages, filling stations	28,000	7,350,000
Power plants, pump houses	1,000	1,080,000
Creameries and dairies	1,500	1,200,000
Miscellaneous structures	16,500	14,360,000
Motor vehicles	62,500	4,180,000
Fires other than buildings	15,500	2,500,000
Hangars and contents	200	10,950,000
Totals	650,800	$396,800,000

NOTE: This table is intended to show experience in occupancy losses against which the corresponding table for one year may be compared. Five-year average figures are less distorted by one or more unusually large losses.

a major factor.

Tables VIII and IX have been added this year in answer to a demand for loss information over a broader time basis. These contain a five-year average of losses by cause and occupancy. It should be borne in mind that this five-year period includes U. S. wartime fire loss experience and thus covers a period of high industrial losses. These figures are useful when compared with corresponding figures for any one year, as changes in trends in occupancies or causes thus become apparent. In this regard, five-year averages are also less likely to be distorted by one or more unusually large losses.

Table IX. Five-Year Average Estimated U. S. Fire Loss by Causes (1941-1945).

	Average No. of Fires	Average Amount of Loss
Chimneys, flues—defective or overheated	48,300	$19,350,000
Sparks on roofs	46,500	10,900,000
Defective or overheated heating equipment	49,000	18,750,000
Rubbish	20,100	3,250,000
Combustibles near heaters	7,500	5,300,000
Open lights, flames, sparks	19,600	8,800,000
Hot ashes, coals	13,200	3,600,000
Oil burners	10,000	5,000,000
Smoking and matches	121,000	30,700,000
Children and matches	25,400	3,750,000
Electrical, fixed services; fire due to misuse, or faulty wiring and equipment	55,700	32,000,000
Electrical power consuming appliances	18,100	7,500,000
Flammable liquids, misc., including home dry cleaning and starting fires with	24,300	11,900,000
Torches, welding, cutting, plumbers, etc.	4,000	6,700,000
Films	600	250,000
Lamps, lanterns, stoves	18,000	8,950,000
Gas and appliances	4,300	2,450,000
Grease, tar, etc.	12,700	4,300,000
Spontaneous ignition	15,700	20,000,000
Fireworks	700	100,000
Lightning	24,700	9,500,000
Thawing pipes	1,800	1,000,000
Sparks from machinery, friction	2,700	2,700,000
Incendiary, suspicious	4,000	7,300,000
Miscellaneous	22,300	9,800,000
Unknown	62,600	135,700,000
Explosions	8,700	13,450,000
Exposure	19,300	13,800,000
Totals	650,800	$396,800,000

NOTE: This table is intended to show experience in losses by cause against which the corresponding table for one year may be compared. Five-year average figures are less distorted by one or more unusually large losses.

Methyl Bromide as an Extinguishing Agent.

There have been numerous requests to the National Fire Protection Association for information on methyl bromide as a fire extinguishing agent. (Other frequent uses of the chemical include: refrigerant, fumigant.) The principal reasons for these inquiries have been the recent adoption of methyl bromide for installed aircraft power plant fire protection and its increased appearance in hand fire extinguishers.

Physical Properties.

To properly evaluate the use of methyl bromide, it is first necessary to inquire concerning its physical properties. The data in the table below constitute the most important features for our consideration along with similar information on carbon tetrachloride and carbon dioxide for comparison purposes.

Among the important features of methyl bromide, as evidenced in this table, are the low boiling point, the vapor pressure, the molecular weight, the heat of vaporization, the density, and the volume of gas generated per pound of liquid at normal temperatures and pressures.

Toxicity.

Methyl bromide is grouped as a Class B poison by the Interstate Commerce Commission. As a gas, the toxic effect depends on the concentration at which it is breathed and the duration of exposure. As far as toxicity is concerned, methyl bromide might be compared with carbon monoxide. The maximum safe concentration for

Factors	Methyl Bromide	Carbon Tetrachloride	Carbon Dioxide
Chemical Formula	CH_3Br	CCl_4	CO_2
Vapor Pressure at 68° F.	1250-mm.	90-mm.	42,959-mm. (undercooled liq.)
Boiling Point	40.0° F. to 40.3° F.	170.2° F.	−109.3° F.
Melting Point	−135.4° F.	−8.68° F. to −11.2° F.	−69.9° F. (at 5.2 atmospheres)
Molecular Weight	94.94	153.83	44.00
Specific Gravity (of liquid). (Water=1)	1.732	1.595	1.101 (at −34.6° F.)
Density (Air=1)	3.27	5.32	1.529
Specific Heat	Liquid: .21 Btu/lb. (32° F.)	Liquid: .356 Btu/lb. (32° F.)	Gas: .358 Btu/lb. (59° F.)
Heat of Vaporization of Liquid	At 68° F. 111.6 Btu/lb.	At 170.1° F. 83.5 Btu/lb.	At 68° F. 63.2 Btu/lb.
Vol. of gas generated per lb. of liquid at 32° F./760-mm. (29.9 in.)	3.7 cu. ft.	2.3 cu. ft.	8.2 cu. ft.

This article, prepared by George H. Tryon, III, of the N.F.P.A. Staff, is based upon data available to the N.F.P.A. Executive Office. It is intended only to present information and is not an official statement of N.F.P.A. policy.—Ed.

human beings (eight hour exposure) is 100 parts of carbon monoxide or 30 parts methyl bromide in 1,000,000 parts of air. It is essentially odorless under normal conditions and is of an insidious nature since the effects of poisoning are not immediately experienced. An odorant (one type giving a skunk-like smell) is used by American manufacturers. Methyl bromide under normal atmospheric conditions vaporizes instantly (increasing the toxic hazard), whereas carbon tetrachloride does not vaporize except under actual fire conditions. On the other hand, the heat of a fire does not appear to increase the production of the toxic by-products of methyl bromide as markedly as in the case of carbon tetrachloride. Compared to carbon tetrachloride, therefore, equal caution must be exercised under slightly different circumstances. In liquid form, both methyl bromide and carbon tetrachloride are skin irritants.

In the presence of air and burning material, methyl bromide may theoretically decompose to form carbon monoxide, hydrobromic acid, carbonyl bromide, and bromine, in reactions comparable with those reported in the case of carbon tetrachloride.*

Actual loss of life because of exposure to methyl bromide fumes has been recorded. In one report there were four poisonings (two fatal) from methyl bromide leaking from a fire extinguisher on a ship. Another report tells of the death of a man who worked for two hours in an engine compartment after extinguishing a fire there with this compound. There are other cases of poisoning from the chemical when in use as a refrigerant and as a fumigant.

In the United States, an agreement has been drafted for proper labeling of methyl bromide cylinders between the Surgeon General of the United States and any manufacturer of methyl bromide systems for the protection of aircraft power plants.

Use as an Extinguishing Agent.

There are two distinct methods of using methyl bromide as an extinguishing agent.

The direct stream method (where a jet is directed at the base of the fire as from a hand extinguisher) is possible since methyl bromide boils at 40.0° F. and thus exists at normal temperatures and pressures as a vapor. In an extinguisher, it exists as a liquid since the cylinders are pressured with nitrogen to a pressure higher than the vapor pressure. When discharge of a cylinder is initiated, the liquid tends to vaporize as soon as it leaves the nozzle, or even in the delivery tube itself if the nozzle pressure is lower than the vapor pressure. It is the blanketing effect of the dense gas which is chiefly responsible for the resultant extinguishing action along with some chemical reactions, the nature of which have not been identified. The cooling action accompanying the discharge seems to have only a minor effect.

The flooding method can be compared with carbon dioxide and carbon tetrachloride by an analysis of the concentrations required to effect extinguishment. The percentage of a gas in dry air which will produce extinction of fires depends on many conditions, including the type of contents (various materials differ in the amount of permissible oxygen to extinguish or prevent reflashes of fire), the maintenance of the dilution achieved, and the cooling effect of the agent used. In one series of tests by an English manufacturer, the percentage of methyl bromide required was shown to be 3.0%, the corresponding figures for carbon tetrachloride and carbon dioxide being 15% and 29%

*QUARTERLY, Vol. XIV, pp. 221, 237; *Handbook of Fire Protection*, 9th Edition, p. 710.

respectively, but insufficient information is at hand to evaluate these tests completely. One American manufacturer shows the percentage to be 6% for methyl bromide, 28% for carbon dioxide using butane as the combustion agent, but points out that, pound for pound, the volume of methyl bromide vapor is only about half that of carbon dioxide, and also that the relative percentages of the gases may vary in different fires. At any rate, it is apparent that a smaller concentration of methyl bromide can be expected to achieve extinguishment than with the other two agents. After methyl bromide is used, however, and the fire extinguished, it is necessary to test the atmosphere before men can enter any area which has been flooded with the gas because of the life hazard involved. A halide lamp is usually used for this purpose and consists of a blow lamp burning methylated spirits, fitted with an aspirator tube and a copper rivet for a color element. The flame is normally colorless, and changes color in the presence of methyl bromide according to the following table:

Parts per million of Methyl Bromide in the Air	Flame Color
0	Invisible
50	Faint green
100	Medium green
200	Dark green with trace of blue
500	Blue green
1,000	Strong blue

The electrical resistance of methyl bromide is very high. This property makes it suitable for use in Class C fires where the toxicity hazard is not a factor. It is also effective under the same conditions for Class B fires involving flammable liquids, since its chief extinguishing action is that of blanketing the fire and because the gas is heavier than air, is most dense, and can penetrate "pockets" which otherwise could not be reached by liquid streams.

Present Usage.

The use of methyl bromide for fire extinguishing purposes has advanced much more markedly in England than in the United States. In the September, 1945, issue of *Fire* (official journal of the British Fire Service), it is stated that this agent was used most successfully on British naval craft for the protection of the engine room and infers that it was also used in aircraft, army tanks, and other wartime combat vehicles. In all instances, the operation of the methyl bromide was apparently from a fixed battery of extinguishers rather than from hand operated units, although the article states that the hand equipment is available in sizes ranging from ½ pound to 8 pounds of the liquid chemical. Notwithstanding this reference to the use of methyl bromide extinguishers, the Fire Offices' Committee, which lists approved fire extinguishing appliances for application in the British Empire, has specifically disapproved the methyl bromide type on the basis of its toxicity and because the vapors are rather hard to detect, not unpleasant to breathe, and thus are considered particularly hazardous to human life.

In the United States, methyl bromide in sealed containers has been developed for use in multi-engine aircraft power plants by two leading manufacturers of fire equipment. These installations do not expose human life to the toxic vapors by virtue of distant control valves, and the disagreeable odorant added warns any person accidentally exposed of the danger. Marking the cylinders to indicate toxic dangers also safeguards personnel who might be subject. Other than this, it has not been in general use, although there are one or two hand extinguishers currently on the market which employ this toxic gas without identification of the agent or its hazards.

Recent Aircraft Tests Using Methyl Bromide.

In the most recent methyl bromide tests known to the National Fire Protection Association, the agent was used in comparison with carbon dioxide at demonstrations by the Army Air Forces at Wright Field, Dayton, Ohio, on May 24, 1945, for aircraft engine fire extinguishment. These tests were under the jurisdiction of the Equipment Laboratory, Engineering Division of the Air Technical Service Command (now Air Material Command). In all the tests conducted, a fire was provided in Zone 1 (engine section) and allowed to burn back to Zone 2 (accessories section), where the only fire extinguishing equipment was provided. This equipment consisted of a single ring of perforated tubing which was used progressively for the discharge of carbon dioxide and methyl bromide. In addition, three different types of fire detectors were mounted in the accessories section and were tested for their proper functioning. A slip stream of approximately 120 miles per hour was simulated by means of "prop-wash" from an aircraft engine mounted directly in front of the test installation. The fires were started through the use of aviation gasoline provided to the engine section at the rate of five gallons per minute. After original gasoline ignition, oil was added at a rate of eight gallons per minute to simulate the worst fire condition possible in the aircraft. (Oil fires are harder to ignite, but give off more heat.)

The first test was with two CO_2 extinguishers with flood valves and a total capacity of 10 lbs. These two extinguishers had a total weight of 30 lbs. The gasoline was ignited by a special igniter which consisted of a quick-burning powder activated by a resistance wire that was heated electrically. As the fire reached maximum intensity, the prop was feathered, the fuel and ignition cut off and the extinguishing agent released. The result was immediate and effective extinguishment.

The second and third tests used 7 lbs. of methyl bromide from a single cylinder, the total weight of which was 12 lbs. full. This reduction in weight was most significant and is partially accomplished by reduction in the weight of the cylinder itself, made possible by a similar reduction in pressure from 800 lbs. per sq. in. (as in the CO_2) to 400 lbs. per sq. in. This lighter cylinder weight for methyl bromide is most important in tactical aircraft, where weight and balance play such a vital part in design and maneuverability. Extinguishment with this agent was equally effective as with the carbon dioxide, even when the fire originated forward of the cylinders. The quantity used (7 lbs.) was not intended to represent an established criteria, merely a quantity established for the individual tests. Three very important steps are required for successful extinguishment of engine nacelle fires and they were emphasized during this demonstration: (1) feather the propeller; (2) cut supply of fuel to engine; (3) turn off ignition. Unless these steps are taken, reflash or failure to extinguish the fire with any agent is highly probable.

It should be mentioned, also, that methyl bromide (melting point being –133.3° F.) operates with greater efficiency at low temperatures (–40° F. to –65° F.), liable to be encountered at high altitudes, than does CO_2 which has not been fortified with nitrogen to aid in expelling the gas.

There are two methods of installing the extinguishing system: providing a central reservoir or providing a unit system for each individual engine or nacelle. There are advantages and disadvantages to both

systems. Carbon dioxide is more adaptable to the central supply arrangement than is the methyl bromide, since the latter has corrosive problems as well as toxic hazards, and any leakage will present difficulties. The problem of corrosion with methyl bromide is serious with aluminum and aluminum alloys, as it will attack the metal, form aluminum tri-methyl, and this compound is spontaneously combustible. Methyl bromide, however, has only a negligible corrosive effect on stainless steel (used for the container and in many parts of the nacelle) whether its moisture content is high or low. Methyl bromide, with moisture, forms hydrobromic acid upon decomposition and this may be highly corrosive on certain metals. For these reasons, it is probable that the methyl bromide installations will be of the unit system type and that the cartridge, sealed at the factory, will be mounted in each nacelle in lieu of central supply requiring extensive tubing. It may be said that methyl bromide, pound for pound, is a better aircraft power plant extinguishing agent than carbon dioxide, but its corrosive nature and toxic character are disadvantages which must be thoroughly investigated and individually engineered for each type of aircraft on which an installation is accomplished.

Conclusions.

The conclusions which might be drawn from all information now available on this subject are that methyl bromide might be successfully used wherever the toxicity is not a concern and the corrosion difficulties can be overcome. Its use in hand extinguishers involves a toxic hazard such that the general use of this type of extinguisher cannot be recommended. Any area which possesses or did possess a concentration of methyl bromide must be tested to assure there is no toxicity hazard before persons enter the area. Charging or recharging and production of methyl bromide must be carefully supervised to avoid hazard to life.

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Acme.

The Whiting Refinery of Standard Oil (Indiana) was the scene of this fire on June 12, which started in the barrel house and spread to the storage section through barrel passageways. Loss was set at $250,000.

Recent Fires.

Following the procedure started in the 1946 QUARTERLY, we again present a review of a selected group of important and interesting fires reported to the N.F.P.A. Department of Fire Record during the past quarter.

April 14, 1946, Kirkby, England. Cotton Sorting Depot:

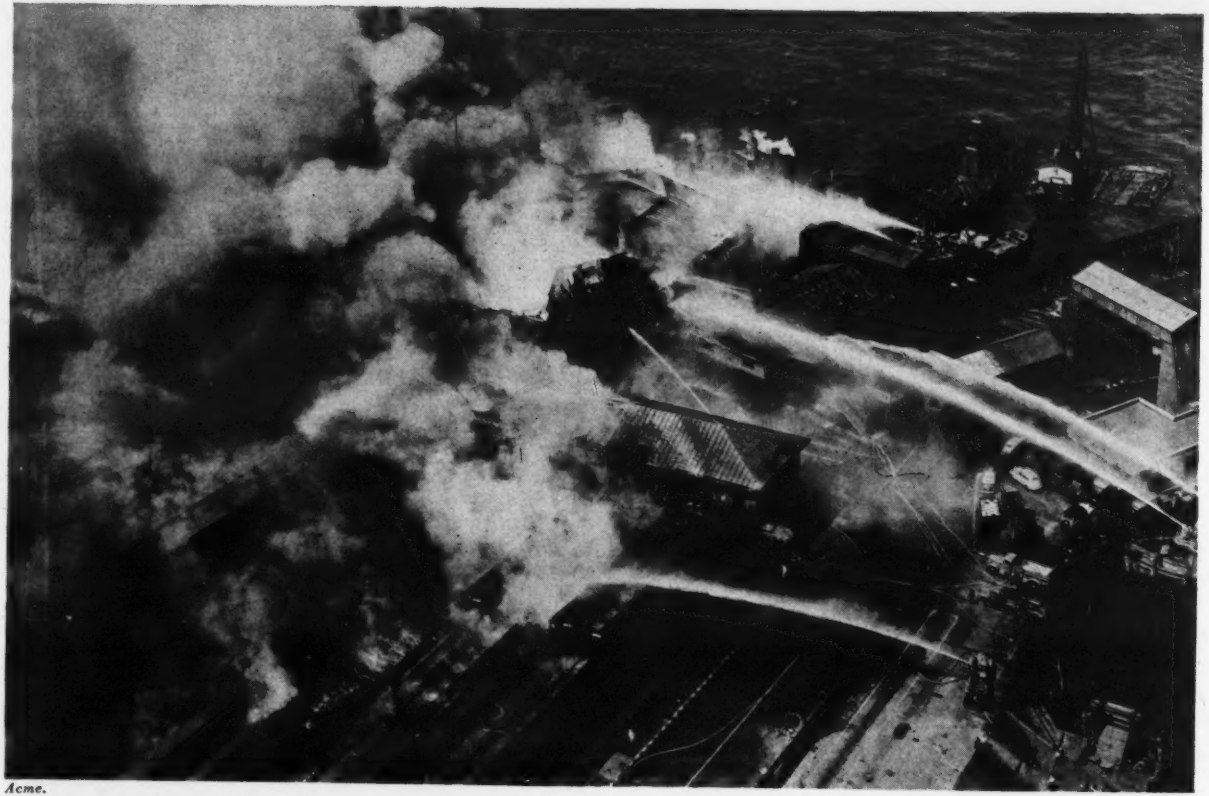
Construction deficiencies, particularly serious in view of the high hazard occupancy, played a significant part in a disastrous fire which heavily damaged a large cotton sorting depot, destroyed 13,000 bales of cotton, and spread over a 30-ft. open space to destroy 300 vehicles in heavy wood packing cases. The property involved consisted of a "dutch barn" type shed, 1012 ft. long by 140 ft. wide. Mounted on a concrete platform about four feet above the ground level to facilitate handling of stock from railroad cars, the shed had a roof of corrugated iron with bitumen-coated sheet asbestos on either side, supported by unprotected structural steel frames. It was divided into three sections by ineffective brick walls (lacking parapets) which extended only to a point 20 feet short of the edges of the concrete platforms on each side. The brick walls had large, sliding, single doors supported by steel angle frames. It can readily be seen that the fire resistance of the structural members, essentially non-combustible, was, in fact, less than 15 minutes under actual fire conditions. The fire started from an unknown cause in one of the end sections where cotton was stored in bales piled 16½ ft. high. Flames spread to and along the roof coating with lightning rapidity and the entire structure was almost instantaneously involved. The center section, where the cotton was stored only one bale high, did not collapse as did the two end portions. The cotton in this section was only slightly damaged. This was attributed to the fact that the flaming bitumen coating, dropping from the inside surfaces of the roof, was burned out before coming in contact with the cotton. In the other sections, where the cotton was stacked to the roof, ignition resulted and total losses were sustained. The extent of the fire can be visualized by its spread to the open storage of vehicles in heavy wooden packing cases over a clear space of 30 ft. This fire re-emphasizes some established principles of fire protection engineering: (a) lack of automatic protection; (b) concentration of abnormally large values of combustible materials in a single fire area: (c) use of unprotected steel frame construction in a high hazard occupancy; (d) employment of a metal roof with combustible coating in a structure housing highly flammable contents; (e) difficulty in extinguishing a fire after structural failure. Total loss estimated at over $1,000,000.

June 12, 1946, Whiting, Ind. Refinery:

Flames spread from the basement of a small building in which barrels were filled to a three-story, brick building (275 ft. by 75 ft.) used for barrel storage through two metal and transite barrel passageways. Exploding drums spread the fire quickly, igniting the wood roof and threatening other refinery buildings. Employees within the buildings involved managed to escape without injury as the private and public fire departments poured water on the inferno from all sides to confine the damage to the two structures. Forty private hose streams were used (supplied by a system of high pressure fire pumps) while public agencies used three 2½-in. lines. A metal-clad door at the end of a pipe tunnel between the barrel filling building and the compounding plant, plus the use of steam, prevented the flames from involving the latter. The cause was attributed to a short circuit in electrical wiring in the filling room. Loss estimated at $250,000.

June 25, 1946, Medford, Ore. Conflagration:

Fire, which swept a 38,000-sq.-ft., two-story, frame, fruit packing plant lacking automatic sprinkler protection or fire wall divisions, subsequently destroyed three city blocks in the heart of the industrial section. Originally discovered at 6 P.M. by one of two employees in the building, the alarm was delayed until the flames were noted by an outsider (located a block away) coming through the roof. The explanation for this delay, contained in the report, was that the spread of fire was so rapid that the building's telephone could not be reached despite efforts to do so. Attempts by the fire department to halt the spread of the flames were heavily handicapped by a sixteen-mile wind, large quantities of orchard spray, insecticides, wooden box shooks, paper wrapping materials stored inside the building, and sizeable quantities of wood fruit boxes both inside and outside the structure. First exposure to become involved was a two-story, reinforced concrete



Acme.

Four fireboats and thirty-eight engine companies fought the largest fire in Staten Island's history on June 25, when the Municipal Ferry Terminal was totally destroyed.

building across a street 60 ft. wide. Fire entered this structure through louvres, wooden doors, and melted-out wire glass windows. Efforts to stem a further advance of the fire to other highly valued properties adjoining this structure were successful due to a shift in the wind (attributed to thermal drafts resulting from the fire), by the superior construction (concrete), and fire department hose streams. This stop was permanent, but the change in wind involved other properties, including a block-sized lumber yard, lumber mill, and lumber processing plant, and, simultaneously, another one-story, frame, packing plant. The latter exposure was aggravated by the ground storage of packing boxes which provided a continuous supply of fuel to the fire over the 44 ft. separation between buildings. While the flames again jumped a 60-foot street to destroy a private frame garage, the determined stand made by the Medford Fire Department, a group of volunteers (many former "call" men of the department) and outside departments responding to a call for aid despatched at 6:30 P.M. saved a row of frame dwellings which were heavily exposed for over 45 minutes. A row of shade trees assisted in the latter battle, as they acted to break up the radiant heat. The fire was declared under control by 7:30 P.M., but mopping-up operations continued through the night. Adequate water supplies were available throughout the fire at hydrant pressure averaging 70 lbs. under the most severe conditions. An estimated half-million gallons were used on the fire. Loss was estimated at $1,000,000.

June 25, 1946, St. George, Staten Island, N. Y. Ferry Terminal:

The biggest fire which ever struck Staten Island broke out at two o'clock in the train pocket of the Municipal Ferry House, destroying both the train and ferry facilities before being brought under control by approximately 3000 firemen who worked over a period of three days. Help from Manhattan proper had to be routed 16 miles through the Holland Tunnel to reach the scene (for the first time in history). Two persons were trapped by the rapid spread of the flames through the forty-year-old structure and a third was fatally burned. It was considered most fortunate that the fire broke out just after 500 patrons had left the dock on the 2 P.M. ferry, leaving the large second floor waiting room virtually deserted. The fire was attacked from both the land side (38 engine companies) and by fireboats, which threw an estimated forty-eight million gallons of water on the blazing dock. Apparently starting in grease and oil drippings on the wood structure underneath the railroad platform, possibly from a discarded cigarette, the flames communicated to the wooden roofs and platforms of adjoining terminal tracks, to fourteen empty steel railroad passenger cars, to the main ferry terminal, concessions, offices, drop bridges, and ferry slips.

Acme.

This aerial view shows the extent of the Medford, Oregon, conflagration of June 25. Fire, starting in an unsprinklered frame packing plant, wiped out three city blocks before being subdued.

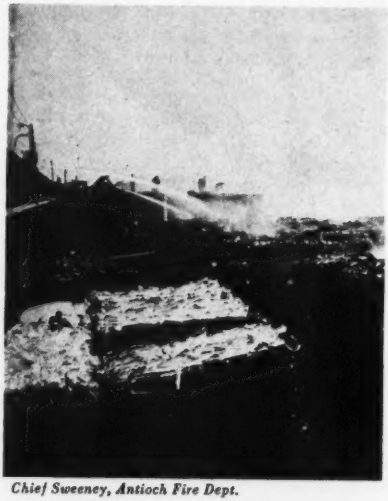
The most stubborn fire was in the wooden piling and substructure, and the creosoted pilings produced a very irritating smoke, causing fire fighters much discomfort. Holes had to be cut in the reinforced concrete decking topping the wooden underpinning with air compressor drills, and this operation took approximately 2½ hours for each of thirty such openings. Cellar pipes and distributors were used in combating the lingering flames. Loss estimated at $2,000,000.

June 27, 1946, Antioch, Calif. Paper and Straw in Stacks in Open Yard:

High winds plus a delayed alarm allowed flames to sweep over five acres of waste paper and straw in stacks 25 feet high in an open yard of a fiberboard products plant. Starting in a straw stack in one corner of the fifteen-acre plant, the flames threatened the entire plant, valued at $6,000,000, but substantial brick construction (without window openings), fire-resistant roofing, and fire doors, plus protective hose lines from six fire companies and interior automatic sprinklers, prevented a much greater loss. The watchman who discovered the fire became excited and when the alarm was pulled from a street alarm box the simultaneous pulling of a second alarm prevented a clear signal, as the system did not embody the non-interference feature. The rapid spread of flames forced mill employees to abandon a charged hose line in the storage area, forcing all the private yard system to be cut off to avoid unnecessary bleeding of the supply. The city fire department plus mutual aid forces, however, had available city high pressure mains (18-inch) and thus were able to establish control of the flames. The paper stacks were flooded, using fourteen 2½-in. and 1½-in. hose lines (including monitor nozzles) as the straw stacks were allowed to burn out and exposures protected. The blazing paper was scattered by the 20 m.p.h. wind and nine separate fires were started in the vicinity, the largest burning over 300 acres of ranch land 1½ miles away. Loss $250,000.

July 1, 1946, Valley, Neb. Popcorn Processing and Warehouse:

A three-story, frame, unsprinklered popcorn and feed warehouse and an adjacent one-story, frame popcorn crib were destroyed by a fire first discovered at 7:30 P.M. Originating in a room where stocks of tin cans were stored in their paper wrappers, the only theory advanced as to possible cause was that boys who had been playing in the vicinity set the fire with fireworks, purchased despite state and local ordinances prohibiting their sale. By the time fire



Chief Sweeney, Antioch Fire Dept.

Flames swept over five acres of waste paper stacked in this Antioch, Calif., fibreboard plant on June 27, and threatened the entire plant.

fighters could reach the scene, the three-story structure, with a total ground floor area of 7400 sq. ft., was in flames. Mutual aid from three neighboring fire departments prevented the destruction of exposed frame dwellings, localized damage to the roof of an exposed, two-story hotel, but, because of weak water supply and the quick-burning materials involved, was unable to stop the spread to the frame crib housing 20,000 bushels of popcorn and 10,000 bushels of field corn, oats, and packaged popcorn. Loss: $250,000.

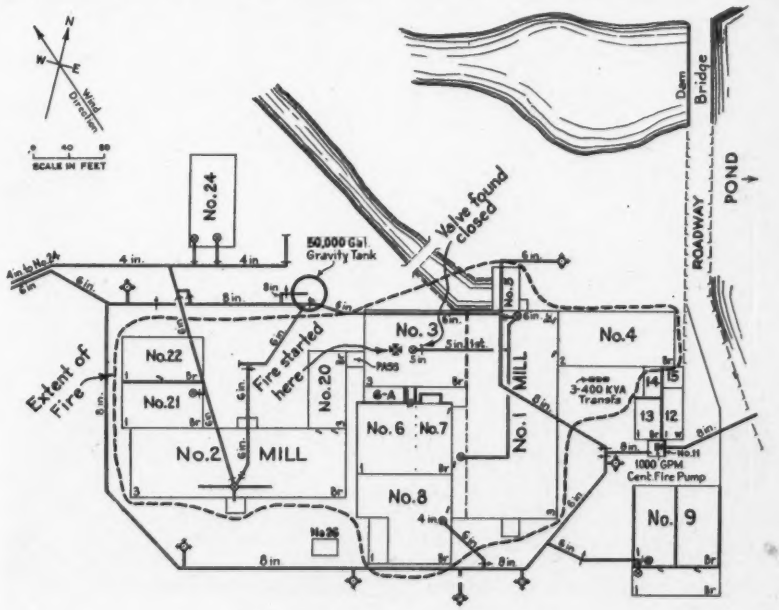
July 2, 1946, Dinuba, Calif. Winery:

Use of a blow torch in a distillery room caused an explosion and fire which eventually destroyed a large winery and about 350,000 gallons of wine. The explosion was apparently the result of the open flame coming in contact with alcohol fumes as the maintenance man attempted to unsolder a slip joint in the still room. The flames traveled rapidly through the old (1883) wood, mostly one-story, unsprinklered plant, fed by oil and natural gas located near the point of origin. A 10 m.p.h. wind caused the flames to spread to the main winery building, also of frame construction without fire division walls, about 20 feet away before the nearest fire department (five miles distant) could reach the scene. Mutual aid was called from four neighboring towns, and eight hose lines were used to successfully protect the office building and

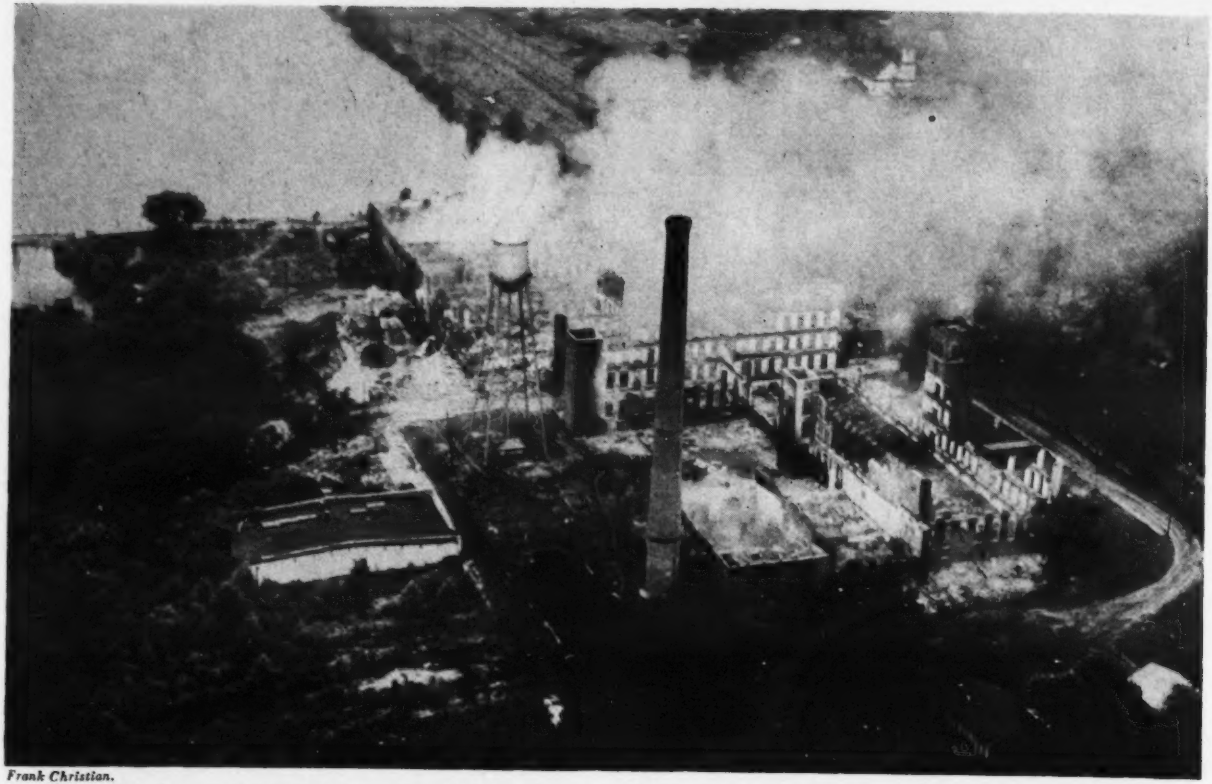
brandy section. Water was supplied through a pump from a near-by irrigation ditch. The same plant suffered a previous fire on December 8, 1940, when 16 vats of wine were destroyed, causing a loss of $200,000. Loss on this fire estimated at $600,000.

July 3, 1946, Langley, S. C. Warehouse—Textiles (Various Tenants):

This plant, originally operated as a full process cotton mill, consisted of a group of adjoining one- to three-story and basement brick buildings having plank on timber roofs and floors. Fire cutoffs between buildings were only fair, consisting of partial fire walls with single, three-ply, tin-clad fire doors at openings. Automatic sprinkler protection was provided throughout the main buildings and was supplied through looped yard mains from a 50,000-gallon gravity tank, a 1000 g.p.m. centrifugal pump, and a 1000 g.p.m. underwriters' pump taking suction from an inexhaustible pond water supply. The present tenants were using the mill buildings for storage of textile fibers, cloth and bleachery supplies, and the plant was idle for the week of July 1 with one watchman on duty. At 7 P.M. on the night of the 3rd lightning appeared to strike the plant. The watchman noted no fire on his 7 P.M. round, but while on his 8 o'clock circuit he discovered a small fire on top of a bale of cotton on the third (top) floor of one of the central mill buildings. He believed he extinguished this fire by beating the flames out with his hands and using a pail of water on the remaining burned cotton. At 9 P.M. only the odor of smoke was noted and dismissed as originating from the early blaze. At 10 P.M., however, the watchman discovered the entire third floor in flames and promptly proceeded to the fire bell in a tower of an adjoining three-story building. When employees arrived they found the flames coming from the third story windows. It should have been obvious that the sprinklers were not functioning, but no one checked the control valve (located on the first floor), and it was later discovered that this valve had been closed to make some minor repairs some time previous and never reopened. Three hose lines were laid by employees from the yard hydrants, and directed into the hopelessly involved floors instead of being more successfully employed to prevent spread of fire into the adjoining structures. By 10:15 the fire had progressed to the second floor of the first building involved and through the roof. The floors collapsed at 10:35 and this broke the main inside sprinkler riser (five-inch)



Plan of the Langley, S. C., warehouse.



Frank Christian.

This aerial photograph shows the remains of the Langley, S. C., textile warehouse which was completely destroyed on July 3. Automatic sprinklers were improperly closed, an untrained watchman erred in judgment, and local fire departments were found wanting of advanced planning.

below the valve. Fire fighters arrived from Aiken, Graniteville and Augusta, and provided additional hose lines. Two of these lines were also connected to the yard system with the result that when electric power failed (stopping the fire pump) the fire defense was so weakened that flames spread to the four other of the mill buildings (separated by an alley) before lines could be rearranged to take suction from the pond. While five buildings were eventually saved, by 3 A.M. the bulk of the plant and its valuable contents were lost. The lessons learned from this fire are multiple but may be divided into two general categories. Fire protection of the physical structure obviously had been thoroughly planned but was ineffectual on July 3rd, 1946, because: (1) the control valve in the 5-inch riser to supply the third floor sprinkler system was improperly closed; (2) the relief watchman on duty was not trained, did not know the location of the valve, how to start the fire pump, or what precautions to take in the event of a fire; (3) the fire wall cutoffs were inadequate; (4) the fire doors were unsatisfactory; (5) lack of metal-sashed, wired-glass windows influenced the spread of fire across the 12-ft. alley; (6) the yard water supply system was exposed to damage from falling walls; (7) the main power station proved vulnerable to fire damage; (8) control valves located inside the building instead of outside subjected them to breakage; (9) the storage of large quantities of baled cotton, rayon and other combustible fibers in one fire area subjected all to a total loss.

The outside fire suppression facilities and techniques were deficient in the following ways: (1) there was no mill fire brigade organized to efficiently handle the fire at its incipiency; (2) private hose lines were in poor condition; (3) a great deal of time was lost due to misdirection of hose streams with ineffectual results; (4) no one inspected the sprinkler control valves, no one opened the closed valve, no one shut off the valves after collapse of the floors and consequent breakage of the risers; (5) too many hose lines were taken from the yard hydrants instead of drafting from the inexhaustible supply in the pond (this action depleted the supply to operating sprinklers); (6) points of exposure were not covered by protective hose streams; (7) outside fire departments delayed sending equipment until authorized to go beyond municipal limits; (8) there was an obvious lack of pre-planning in fire department operations. Loss: property damage, $2,840,000; use and occupancy, $1,000,000 (plus).

July 11, 1946, Reading, Pa. Airplane fire:

When a Lockheed *Constellation* crashed in an alfalfa field one mile from the Reading Municipal Airport, the fire which resulted was actually an extension of fire suffered while in

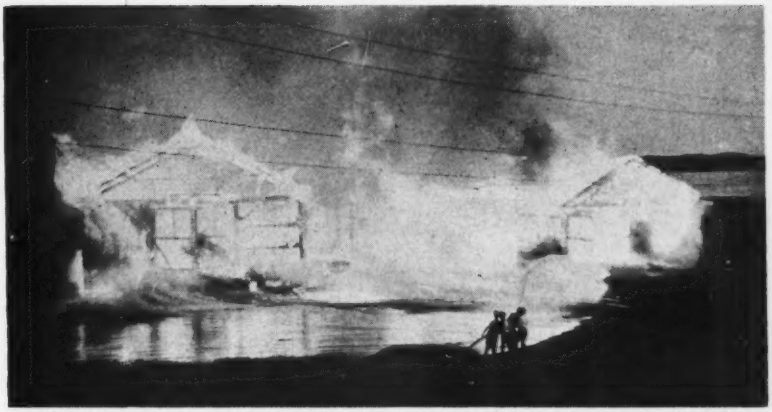
Press Association.

The burned-out fuselage of the "Constellation," which crashed near Reading, Pa., on July 11, is grim testimony as to the origin of the fire sustained in flight which cost the lives of five out of a crew of six on a routine pilot training flight.

flight. This accident, causing the death of five out of a crew of six aboard during a routine pilot training flight, was the second fire in the air suffered by this model aircraft (see July, 1946, QUARTERLY, page 72) and resulted in the grounding of all Constellations in commercial use throughout the world pending investigation by the Civil Aeronautics Board. After exhaustive research and testimony by the sole survivor it was definitely established that the fire was caused by a faulty electrical connection designed to conduct current from the engine-driven generators through the air-tight cabin walls to circuits inside the aircraft's fuselage. The conventional airlines with unpressurized cabins have uninterrupted cables leading to cabin and battery, but in the Constellations six lead-in cables stop at the pressurized cabin wall and the current is carried through by studs which were not properly designed and probably vibrated loose. The resultant arcing occurred against the inside of the cabin wall and set fire to the sound-proofing materials. When discovered by a crew member, the fire had progressed markedly through the empty passenger compartment and strong indications point to the conclusion that hydraulic fluids had also been ignited. The pilot's compartment and wing fuel tank were not involved in the original fire, but as fate would have planned it, two of the four engines had been cut-out, just before the fire was discovered, for training in two-engine operation (a necessary instruction for safety purposes). The smell of smoke prompted one of the crew members to open the flight deck door and smoke poured forward to obscure not only ground but also instrument vision as frantic efforts were made to start the "dead" engines again, one of which was back-firing alarmingly. The pilot then opened the cockpit windows to improve his ground vision (aircraft was at approximately 3000 ft.), saw he could not reach the airport, and attempted to land in the alfalfa field. Crash crews rushed to the scene after the alarm was given via radio from the pilot of a near-by aircraft and employed fog and foam in efforts to blanket the fire and accomplish rescue. The sole survivor had been extricated by a near-by resident before any fire equipment reached the scene. Reading City, Hyde Park and Laureldale pumpers also responded and water was relayed as rescue men were protected with fog. The accident greatly stimulated C.A.B.'s investigation of the aircraft fire problem, started after the Eastern Air Line crash (DC-3) near Florence, S. C., on September 7, 1945. New fire regulations have just been announced by the C.A.B. for all aircraft, and approximately fifty changes are specified for the Constellation type to remove fire hazards. Loss: $750,000.

Acme.

This distillery fire in Ripon, Calif., on July 11, destroyed a large portion of the lightly constructed, sprinklered plant after an explosion ruptured the protection plumbing and cut off power to the fire pump.



This view of the Pictou, Nova Scotia, pier fire of July 14 shows two of the three piers destroyed ablaze. Loss was estimated at between $800,000 and $1,000,000.

July 11, 1946, Ripon, Calif. Distillery:

One basic lesson in division of fire hazards was illustrated by a fire which destroyed a large section of a brandy distillery and warehouse and consumed, among other contents, 20,000 gallons of high proof alcohol and eight carloads of grain. This basic lesson, failure to adequately cut off the boiler from such hazardous operations as alcohol distillery, is believed to have been the cause of the explosion which occurred at 12:31 P.M. The alcohol fumes were ignited by fires in the boiler room, seriously injured one man, blew the roof off the four-story still tower, disrupted telephone service (only means of transmitting the alarm) and damaged the plant power transformers, which caused failure of the domestic pump. Automatic sprinkler piping installed in the building of origin was ruptured, and lack of a trained fire brigade resulted in the rapid draining of the 100,000-gallon gravity tank which supplied both yard hydrants and the sprinklers. Fire fighters from the town responded after a telephone call from an off-duty superintendent, who heard the explosion from his home a mile away. Neighboring towns also sent aid within half an hour. Booster tank supplies were quickly exhausted as flames raced through the 20,000-sq.-ft. buildings, which were of mixed frame, iron-clad and hollow tile wall construction. Water was then drafted from supplies stored in wine tanks in a winery building located 250 feet away. At 1:10 P.M. the gravity tank failed. At 2:30 P.M., soon after the sprinklered pipe shop was involved, the flames spread to the sprinklered brandy warehouse 50 feet from the distillery. No attempt was made to connect the water supply still available from the wine tanks to the sprinkler systems of either of these buildings, although this could have been done if a pumper had been used to connect to one of the hydrants on the interconnected system. Loss estimate: building, machinery and equipment: $250,000 (value $373,000); stock, $450,000 (value $4,000,000); total, $700,000 (16% of total value).

July 14, 1946, Pictou, Nova Scotia. Piers:

Three piers, each 600 ft. long, were destroyed in a fire which started in a concealed space under the wood decking and burned for considerable time before being detected. A new ferry boat, three other boats, as well as nine loaded railroad freight cars, were also heavily damaged before the fire could be controlled. It was on a Sunday evening, and the pier was unoccupied except for boys swimming around the end and several men sitting on the side of the wharf passing the time of day. At about 7:30 P.M. smoke was noticed, but it was not until almost 8:00 that its source was discovered. One of the men present ran for a telephone, but the nearest buildings were closed and it was not until 8:12 that the alarm was placed. As the local fire department responded with its single pumper, flames were coming through the roof of the two 400 ft. x 100 ft. freight sheds, entirely of frame construction, and it was evident that help was required. One pumper was dispatched upon call from the nearest town (18 miles away), but the best that the combined fire fighters could do was to prevent spread to the shipyard, which, if involved, would have seriously threatened the entire town. Fire suppression was handicapped by a stiff breeze, by the dry conditions which had existed during the

previous weeks, and by the highly flammable nature of the construction and the contents. Absence of any automatic fire protection facilities and the wide area involved was a severe tax on the limited town fire department facilities. Loss estimated at between $800,000 and $1,000,000.

July 16, 1946, Rosslyn Farms, Pa. Factory Building (in Process of Conversion):

The watchman of an adjacent warehouse discovered smoke and fire issuing from a 200 ft. x 120 ft. factory building at 7:30 P.M. when he made a scheduled survey of the neighboring property in compliance with pre-arranged two-hourly services. The smoke and flames were observed coming from near a raised wooden-plank platform on which some work, including brazing operations, had been conducted during the day. Although the cause must be listed as unknown, the theory was advanced that sparks from the brazing ignited the planking or nearby combustible refuse, smoldered for a considerable period, and finally broke out about the time of discovery. The watchman first called the nearest fire department, Borough of Carnegie, and then returned with a second watchman in an effort to extinguish the fire with private hose lines available. When fire equipment reached the scene, the flames had forced the watchman out of the building, but the fire was not considered serious enough by the fire chief to call for assistance. Soon, however, the flames had spread to such a marked extent that help was requested from five other neighboring communities and an additional pumper dispatched from Carnegie. The roof collapsed at 7:50 P.M. and the walls gave way, complicating extinguishment operations. Structural steel framing and trusses were seriously warped by the intense heat, and the heavy plank roof, wood mezzanine, and twenty loaded crates of surplus Army trucks were destroyed. Loss estimated between $200,000 and $400,000.

Thirty minutes after discovery of fire on July 16, the wood plank roof of this factory building in process of conversion at Rosslyn Farms, Pa., collapsed, and the skeleton steel framing buckled.

July 19, 1948, Alliance, Ohio. Aircraft Manufacturing Plant:

About 4:35 A.M., a night fireman discovered a trash fire on the outside wall of the plant's maintenance shop. Instead of calling the city fire department, he attempted to extinguish the blaze with two hand-type, soda-acid extinguishers. Just as the extinguishers were emptied, the fire flashed up against the wall, ignited wood window frames, and, eventually, the wood roof of the one-story concrete building. The city fire department received the alarm at 4:45 A.M. and responded with two combination pumpers. Because firemen were unfamiliar with the plant fire protection system, the first lines were laid to a wall type hydrant instead of the yard system. The water supply available to the wall unit was capable of not more than 350 g.p.m. at zero pressure, as it was delivered through two domestic meters and a long run of three-inch piping. The yard hydrants were backed by a 100,000-gallon, elevated gravity tank and were capable of delivering 1200 g.p.m. The delay in getting satisfactory water streams on the fire, the lack of interior sprinkler protection, the highly combustible contents of the structure (including five fabric-covered fuselages in process, the main jig for a new model aircraft, wing jigs, three power driven drills worth $6,000, maintenance machinery, supplies, and spare parts), and the combustible roof were factors contributing to the total loss of the building. The explanation for the sudden flare-up of the trash pile was contained in the report that the trash included scraps of pre-doped fabric. Spontaneous ignition is believed responsible for the primary ignition. Only the fact that a favorable wind existed saved the rest of the recently enlarged, inter-connected, and partially unsprinklered plant from further damage. Fire loss is estimated at $165,000, with a minimum $25,000 use and occupancy loss.

July 27, 1946, Mitchel Field, N. Y. Airplane Fire:

A Grumman *Wildcat* (Navy designation F6F) sustained a fire in flight believed of electrical origin. The pilot made a desperate attempt to bring the ship in for a landing at Mitchel Field and was observed making the normal final approach. The plane landed nose first, however, after a gasoline explosion while still airborne, slid for about 1000 yards on the concrete runway, cartwheeled and broke in half. Fire department observers of the Mitchel Field Fire Department observed the plane in difficulty as it was coming in and spotted crash equipment in the critical zones. As the plane came to rest, the fire was hit with 2250 pounds of low pressure carbon dioxide from the Cardox crash truck, followed by high pressure water fog and foam to assure absolute extinguishment. Rescue was completed within six minutes of the crash and the fire was completely extinguished within one minute. The pilot was found dead when reached, and observers believe that he was asphyxiated while on the final approach. The Commanding General of the Army Air Forces Air Defense Command, Lt. General George E. Stratemeyer, in a letter of appreciation following the investigation, wrote, in part:

"Although there was insufficient time for the Control Tower to notify the Fire Department of an emergency landing, the men and equipment reached the scene very shortly after the actual crash and had completely extinguished the fire within one minute of their arrival. This fire was of the very serious gasoline type so common to aircraft crashes, and the efficient manner in which it was handled reflects highest credit upon the men of the Base Mitchel Fire Department. Such efficiency is, I realize, the result of constant application and conscientious practice of new methods of fire control."

Loss: Unestimated.

July 30, 1946, San Francisco, Calif. Hotel:

The worst fire department loss since 1906 resulted from a blaze which started in the basement of a seven-story hotel and night club building at 2:31 A.M. Four firemen, said to have been wearing oxygen masks, were overcome and trapped in the smoke-filled night club following collapse of the kitchen and clubroom floor (4-in. concrete over ordinary wood-joisted flooring) and the simultaneous development of a back-draft which caused a mild explosion. The probable cause for the deaths is indicated as carbon monoxide poisoning. Two hundred guests in the hotel were evacuated after telephone warning had been given by a night clerk who also gave the fire alarm. Vertical openings in the brick-joisted building and lack of automatic sprinkler or alarm protection again featured in the spread of fire as in the LaSalle and Canfield hotels in June (see July, 1946, QUARTERLY). Light decorative features and furnishings also contributed to the rapid development of this fire, which traveled up inside boxed-in columns to the concealed space above the first floor ceiling, extended up the rear stairway of the hotel, spread to the hallways adjoining on all floors, vented through the skylight, and started a roof fire. Fire also penetrated an open pipe shaft at the second floor and spread to the sixth floor. Fire department response included twenty-four engine companies, six hose companies, twelve ladder companies, chemical, salvage, and rescue squads, and two water towers. Thirty-five 2½-in. hose lines were used along with turret nozzles and the water towers. The inaccessibility of the basement area and the large amount of storage in this area further complicated suppression efforts. Loss estimates run from $100,000 to $400,000.

Official Photograph, U.S.A.A.F.

This view of the July 27 crash of a Grumman F6F at Mitchel Field shows how the heat generated by a fire in flight caused the metal structural parts to collapse. Ground extinguishment was accomplished within one minute.

August 1, 1946, Kingston, Ont. Hardware Store:

An open elevator shaft acted as a flue for this fire, which apparently started in a truck parked in the alley adjacent to the four-story, stone and brick, wood-joisted mercantile building used for a wholesale and retail hardware outlet. The loss was total to buildings and contents despite efforts of fire fighters, as they were handicapped by a delayed alarm and inadequately protected fire wall openings. A policeman first reported the blaze by pulling the street alarm box at 3:18 A.M., and when fire fighters reached the scene the flames were coming

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Duplicating the June fires in the Hotel LaSalle in Chicago and the Canfield Hotel in Des Moines, this hotel fire spread via open stairwells and was fed by highly combustible decorative trim in San Francisco on July 30.

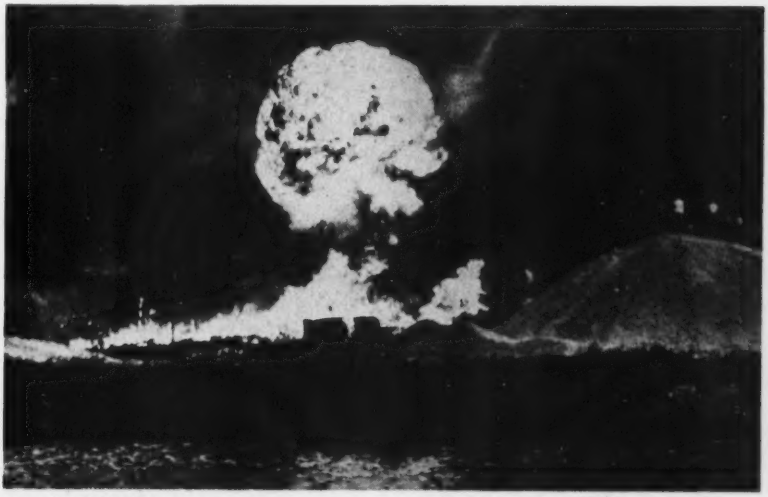
through the roof (metal and part tar and gravel). It was immediately apparent that the newly installed elevator, for which fire doors were planned but not yet installed, acted as the channel for the spread of the flames, and all floors were involved before effective hose streams could be employed. Stocks of paint, oils, automobile supplies, electric light bulbs, glassware and china were totally destroyed, and the paints and oils caused numerous explosions and complicated fire suppression activities. Ten hose lines were used, as well as one aerial truck backed by sufficient water supplies from public mains. Lack of automatic protection and watchman service were other outstanding deficiencies. Loss: $543,000 to building and contents, plus use and occupancy and exposure losses, totaling about $650,000.

August 1, 1946, River Rouge, Mich. Lumber Mill and Yard:

A fire which started in the shavings bin of a sawmill was spread by high winds to adjoining stacks of lumber and logs. From this start, the fire roared across twelve acres of lumber and buildings and threatened to involve near-by dwellings before being brought under control. In the midst of the blaze an explosion of creosote and light varnish in tanks complicated extinguishing operations and caused a tremendous burst of fire and smoke. Lost in the flames were 10 carloads of finished walnut, 40 carloads of other finished lumber, 30 carloads of rough lumber, and 15 carloads of peeled logs. The 12-acre plant employed no watchmen, and the public had free access to the property to pick up scraps of lumber and sawdust. At the time of the fire the mill's chief product was log cabins, built to ease the housing shortage. Loss has been estimated at $1,500,000.

August 3, 1946, Chicago, Ill. Garage:

Absence of watchman service and automatic sprinklers or alarm protection were features of a fire which totally destroyed a 35,000-square-foot garage containing cabs and buses. The fire was first reported by a passing citizen, who saw flames leaping through the roof of the brick-walled and wood-roofed structure at 9:30 P.M. This delay in discovery was the critical factor in the extent of damage that occurred. Twenty-four engine companies responded on five alarms and were successful in protecting exposures despite a five m.p.h. wind. Another fire, which occurred under similar circumstances shortly after this loss, has resulted in an investigation by city authorities, but their findings have not been released to date. This second fire also spread over the wood roof of a 200 ft. x 125 ft. unsprinklered garage, undivided by fire walls, and destroyed fifty cabs of the same operator. Losses sustained are estimated at $175,000 and $90,000 respectively.



Press Association, Inc.

The large ball of fire in the picture occurred when creosote and varnish exploded during the fire at a lumber mill and yard in River Rouge, in Michigan, on August 1.

Wreckage of Sydney, Australia, wool warehouse after fire of August 20, 1946. The seven-story brick warehouse lacked automatic sprinkler protection (provided in many Sydney wool warehouses). The building and contents were completely destroyed, despite good work by the Sydney Fire Brigade, which used twenty-five hose streams on all four sides of the building. Loss £338,000, or over $1,000,000. (Photograph contributed by G. Gordon Russell.)

Acme.

City and Navy fireboats aided land forces in combating this oil tanker fire at Jacksonville, Fla., on August 5. Approximately 9000 g.p.m. of water were thrown on this fire, with twenty streams operating from the water side alone.

August 5, 1946, Jacksonville, Fla. Tanker:

A 500-foot oil tanker docked at Jacksonville with an estimated 38,000 barrels of oil in its tanks. Pumping operations were started and proceeded without incident for about an hour in a severe thunder storm. At 3:36 P.M., however, lightning struck the ship and an immediate explosion and fire resulted. This initial blast blew a hole some twenty-five feet square in the side of the tanker near the rear tank compartment, and from that time a series of explosions occurred for several days. The fire centered in the area between the pilot house and the engine house, and when it originally developed forty men were aboard the vessel. Three lost their lives and the rest jumped off the stern of the ship and swam to a near-by dock or were rescued by boats. The slip in which the ship was berthed was 700 feet long, with one side bulkheaded with one pipeline and the other a combination of bulkhead docks and pipelines. Just before the fire occurred, a strong wind had broken the mooring at the bow and the ship had swung across the slip to subsequently become a serious exposure to both sides. Land efforts to control the fire included eight pumpers, and hose lines were stretched from the private water system until the supply failed and then relayed one-half mile from the city mains. These efforts were further complicated by the fact that there was a gasoline barge with

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Photo shows the wreckage of cabs and buses in the August 3 fire, in Chicago, after the ordinary wood-joisted roof collapsed.

Acme.

Fireboats poured tons of water on the fire of August 11 in the wooden pier and dry dock facilities in the marine repair yard at Staten Island, N. Y.

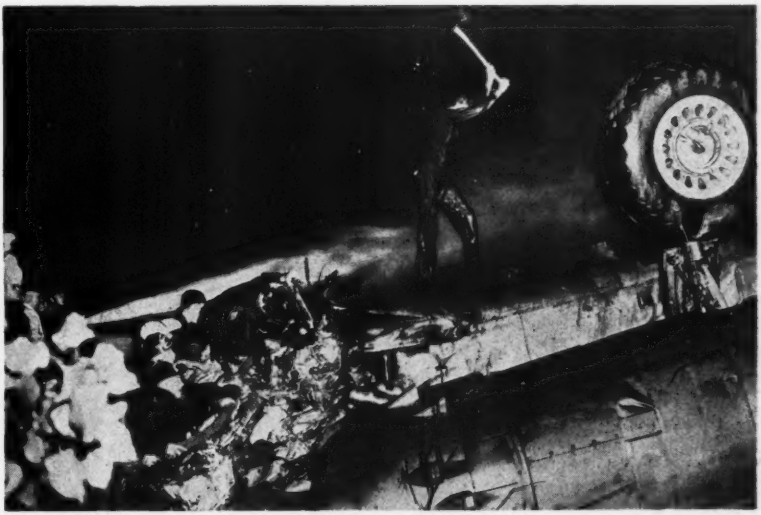
200,000 gallons aboard which could not be moved as it was crossways in front of the tanker. Water curtains were used to protect this barge as other fire fighters sought to protect other oil company property and a creosote plant a short distance away. The loss to docks and pipes was estimated at $50,000, and the tanker loss (costing $3,500,000 to build) is estimated at $1,250,000.

August 11, 1946, West New Brighton, S. I., N. Y. Marine Repair Yard:

The second large fire in Staten Island within two months destroyed two dry docks, a ferry boat undergoing repairs, and a 50-foot barge before being brought under control. Employees discovered the fire at 4:54 P.M. and reported it as being under the deck planking at the river end of the main pier. Attempts to extinguish the fire with private hose streams prior to turning in the fire alarm failed because the base of the flames could not be reached. Pumper equipment was prevented from reaching the dock area because of an intervening railroad track, and hose lines had to be laid across a foot bridge until the electric power could be cut on the railroad lines to safely stretch hose across the tracks. This condition prevented adequate hose streams from being applied in the early stages of the fire until fireboats could reach the scene. The first building to catch fire was a frame machine and blacksmith shop (60 x 200 feet), the flames from this building igniting the drydock (50 x 250 feet) and subsequently the ferry (45 x 225 feet), a two-story frame warehouse (50 x 400 feet), and several smaller pipe and rigging shops. Eventual control was gained by the use of Army, Navy and private tugs from which deck pipe streams were used, and eight 2½-in. hose lines from adequate land water mains and river suction. The absence of a strong wind aided fire fighters in their three-hour battle. This fire illustrates the hazard of combustible pier construction, the necessity for under-pier sprinkler systems, and the hazards in delaying the sounding of an alarm while attempts are being made to fight the fire with inadequate private facilities. Loss: $500,000.

August 19, 1946, near Washington, D. C. Airplane Crash:

An Army B-25 overran the runway at the Washington National Airport during a heavy thunderstorm and crashed amid flames in an inverted position on a railroad embankment. Eight persons were involved in the accident, five of whom managed to escape without assistance, but the remaining three were trapped until rescued by a District of Columbia Fire Department rescue crew. When this rescue was accomplished, the right wing and rear fuselage of the aircraft were burning furiously and rapidly approaching the forward compartment in which



Associated Press.

Despite heavy fire conditions, fire department personnel rescued three persons trapped in this crash at the Washington National Airport on August 19.

Acme.

A large liquor warehouse lacking automatic sprinkler protection and possessing inadequate private water supplies was destroyed by fire when the wood roof was ignited and spread flames throughout the structure. The warehouse was located outside municipal protected zones near Fresno, Calif. The fire was discovered by a watchman at 4:50 p.m. on August 29.

the men were trapped. The rescue crew, protected by hose lines from a pumper, succeeded in manually lifting the plane sufficiently to allow those trapped to squeeze out through the escape hatch of the plane. A portable generator (2½ kilowatt) furnished lights for the scene, and an acetylene cutting torch was used to make entrance into the forward compartment to search for possible additional victims. This heroic fire department action brought an official commendation from the C.A.A. administrator of the airport on behalf of the management and the commanding officer of the Army Air Base located at the field. The response by the District of Columbia Fire Department was outside their normal jurisdiction, and units from the Army Transport Command, the National Airport, and the Alexandria, Va., Fire Department also responded. Loss: unestimated.

August 19, 1946, Omaha, Neb. Farm Implement Wholesale Warehouse and Bottle Storage:

The five-story, brick-walled, heavy wood-joisted (part semi-mill) structure (15,700-square-foot ground area) possessed a non-operative, two-source sprinkler system which had been out of service since 1934. The sprinkler heads and the dry pipe valves were unapproved and had deteriorated to such an extent that the cost of restoration was estimated at $10,000, and, in the words of the manager, "We didn't think the cost was justifiable." The fire, which proved this expenditure would have undoubtedly paid off at a ratio of at least 30 to 1, struck at 5:37 P.M. Discovered first by an outsider and shortly afterward by employees working overtime, evidence points to the fact that it had a considerable start in the fourth and fifth floors among combustible shelving, wood boxes and empty beer bottles in paper cases. While fire fighters were approaching, the extent of the blaze was obvious and a second alarm was turned in via two-way radio facilities. The walls bulged within seven minutes of arrival and top rungs of the aerial ladders were quickly ignited. The walls collapsed, preventing interior fire fighting, within the next few minutes, and all attention had to be concentrated on surrounding properties detached 90 to 130 feet. Despite protective hose lines, exposed windows were cracked and broken, wood window frames scorched, and some interior damage was suffered. A total of 260 firemen were engaged in the extinguishment effort, 16 hose lines were used (supplied by eight pumpers, seven 1000 g.p.m., one 1500 g.p.m.), and the battle continued until about 3:00 A.M., when the fire was pretty well burned out. The extent of the contents loss was aggravated by the destruction of twenty-five carloads of new, hard-to-replace farm machinery which had just arrived. Loss: $360,000.

August 21, 1946, Azusa, Calif. Jet Unit Manufacturing:

Eight persons were killed by the force of an explosion which occurred at the Aerojet Engineering Corporation plant engaged in the production of propellant charges for jet-assisted take-offs of military aircraft. A standard batch of the propellant (a mixture of asphalt fuels and potassium perchlorate) was being mixed in a steel vat when fumes were noticed coming off the surface. The employee immediately notified the plant protection engineer and sounded the local alarm, which resulted in an evacuation of the building. The firemen were just about to turn water on the building when a sharp blast occurred, wrecking the one-story, sprinklered, frame building (3550 sq. ft. in floor area), scattering debris over a wide area and hurling employees distances from 50 to 125 feet. Five were killed outright by the concussion and three others were fatally injured. The blast occurred about four minutes after the fumes were first noticed, but only local grass fires resulted, the force of the explosion extinguishing the original flames. Loss estimated at $100,000.

August 29, 1946, near Fresno, Calif. Liquor Warehouse:

The fire started on the loading platform at 4:50 P.M., possibly from a cigarette spark or some other similar source. The operations had been halted for the day, and only the superintendent and a watchman were on the property. The warehouse was located twenty-six miles outside the city limits of Fresno on a main highway and was flanked, on the other side, by a railroad spur which was occupied by nine railroad boxcars. When the watchman discovered the blaze, the fire was well on its way up the brick walls toward the wood roof of the 75,000-sq.-ft., unsprinklered building. Before fire equipment from the State Division of Forestry and the neighboring town could reach the scene, the roof was heavily involved. As the wood timbers caved in, the highly flammable supplies of alcohol started to explode and ignite. An estimated 10,000 barrels of brandy, 7000 fifty-five gallon drums of alcohol, and 3000 barrels of whiskey were destroyed during the following thirteen hours of fire suppression activity. The lack of automatic sprinkler protection was obviously the most serious shortcoming from the protection point of view. The private water supply was found wanting in vol-

ume and pressure. At the peak of the fire only five 2½-in. hose streams could be used from hydrants located on a six-inch main supplied by a storage tank of 30,000-gallon capacity and an 800 g.p.m. pump. The existence of a firewall between the liquor warehouse and an adjoining cotton compress and warehouse helped firemen save the latter part of the storage facilities. The loss has been estimated in the following ways: Insurance loss: Building, between $190,000 and $250,000; Contents: between $3,600,000 and $5,000,000; government tax loss: $11,700,000 (at rate of $9.00 a proof gallon). Total potential loss thus could reach as high as $16,000,000.

September 5, 1946, near Elko, Nev. Airplane Crash:

An airplane crash, which undoubtedly will produce wide repercussions in the current battle of the so-called "non-scheduled" carriers with the Civil Aeronautics Board's rulings on safety and flight operation regulations, occurred about 1:17 A.M. on the crest of a hill outside the city limits of Elko. The weather conditions were bad—a thick fog—and the chartered DC-3 was groping for a landing at the Elko airport with twenty-two persons aboard. A mistake in judgment or faulty operating procedures resulted in a crash, followed immediately by fire, which killed all save a two-year-old boy. The accident tragically spotlighted the fact that Federal safety regulations differ between the scheduled and non-scheduled operators, and, ironically, that the more restrictive apply to the former, where the pilot experience factor is undoubtedly higher. At this airport, for instance, a United Air Lines plane was forbidden to land under instrument weather conditions unless there was a cloud ceiling of 2500 feet and a visibility of three miles. The non-scheduled plane, however, could legally land under the same conditions with only a 500-foot ceiling and a one-mile visibility, even if the pilot had never landed at the airport previously. Investigation has further disclosed that the Civil Aeronautics Administration never established or approved an approach procedure for Elko, despite a hazardous group of mountain ridges surrounding the field. This airport, along with others, had simply been "overlooked" in the periodically published *Flight Information Manual*, published by the C.A.A. While the crash brought these, and other similar regulation deficiencies, to light, it also illustrated the lack of crash fire facilities afforded for the protection of the air traveler. Only the town fire department was available, and they did not respond, since they could not possibly have reached the scene with their heavy municipal apparatus, and the effectiveness of a small booster pump (the only one available) was certainly open to question. A simultaneous false alarm at the other end of town also proved the unrealistic policy of relying on such facilities for crash fire emergencies. Loss: unestimated.

CLOUDY

CHICAGO DAILY NEWS

5 FINAL

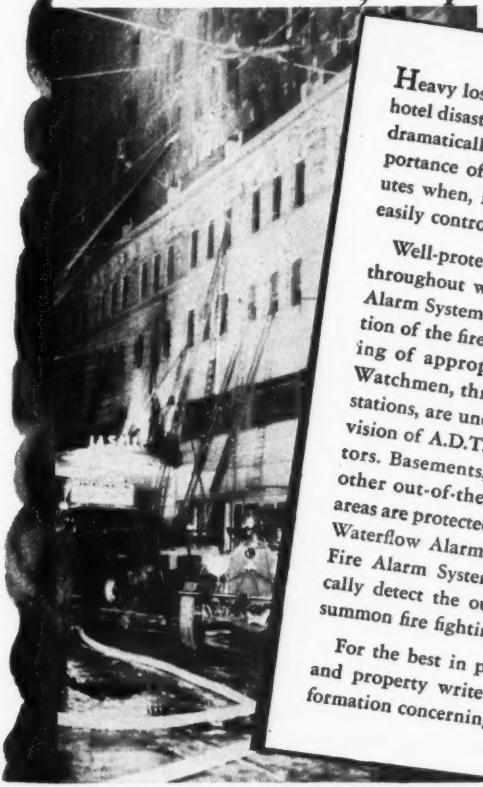
THURSDAY, JUNE 6 1946—FORTY-FOUR PAGES. FIVE CENTS

Witnesses' Story of La Salle Tragedy

DELAY IN REPORTING FIRE TOLD

20 Minutes Lost, Employee Charges

Reveal Blast



Heavy loss of life in the recent tragic hotel disasters at Chicago and Dubuque dramatically illustrates the prime importance of those vital first few minutes when, in most cases, fires can be easily controlled.

Well-protected hotels are equipped throughout with A.D.T. Manual Fire Alarm Systems for immediate notification of the fire department and sounding of appropriate interior alarms. Watchmen, through their reporting stations, are under the constant supervision of A.D.T. central station operators. Basements, storerooms and all other out-of-the-way and hazardous areas are protected by A.D.T. Sprinkler Waterflow Alarm or Aero Automatic Fire Alarm Systems which automatically detect the outbreak of fire and summon fire fighting forces.

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OUR FIRE-PROTECTION

EXPERIENCE

can supplement yours...

Feel free to call on us!

As specialists in the design and application of extinguishing equipment for electrical and flammable liquid fires, we have acquired a mass of information on ways to put out such blazes *rapidly, with minimum damage.*

Perhaps this knowledge can be helpful in supplementing your own. A Kidde representative is ready to work with you at any time.

Any assistance he can offer is, of course, available to you without charge or obligation.

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1051 Main Street, Belleville 9, New Jersey

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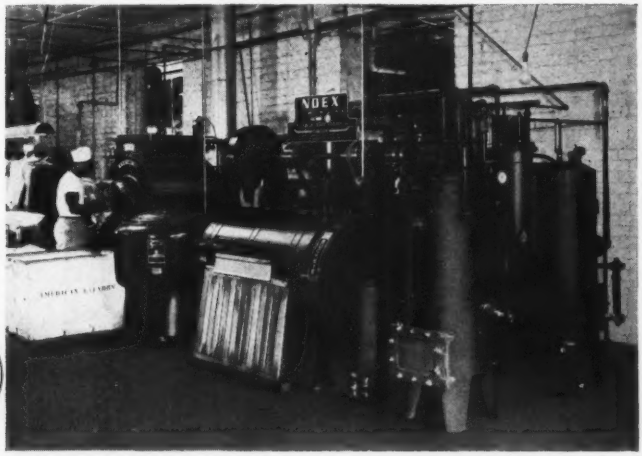

NOEX *in Action*

A typical installation of the Underwriters' Approved NOEX Dry Cleaning Unit is shown above at progressive American Laundry, Wichita, Kans.

Check These Facts About NOEX...

➡ *Noex* is designed to give positive safety protection with all listed petroleum solvents having a flash point of 138.2° F., or over.

➡ *Noex* has been approved by Underwriters' Laboratories as a Class III Unit since 1942.

➡ *Noex* is a quality product of the world's oldest and largest manufacturer of laundry and dry cleaning equipment.

Fully illustrated catalog giving complete details on the Underwriters' Approved NOEX Unit is yours for the asking. Write for a copy today.

The AMERICAN LAUNDRY MACHINERY CO.
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OUR FIRE-PROTECTION

EXPERIENCE

can supplement yours...

Feel free to call on us!

As specialists in the design and application of extinguishing equipment for electrical and flammable liquid fires, we have acquired a mass of information on ways to put out such blazes *rapidly, with minimum damage.*

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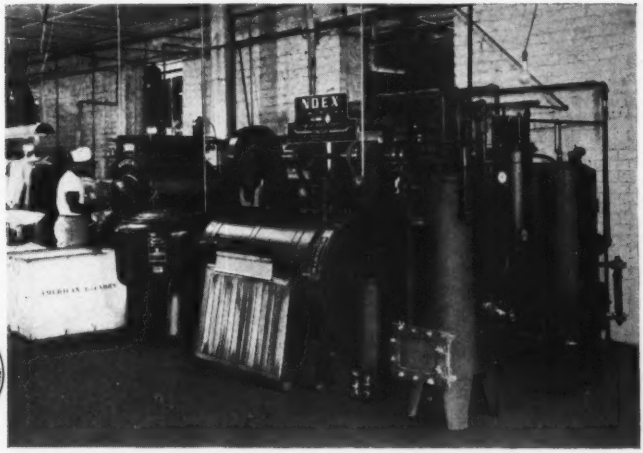

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All of these requisites for SECURITY against loss of life and property by fire are provided through the "ETERNAL VIGILANCE" of

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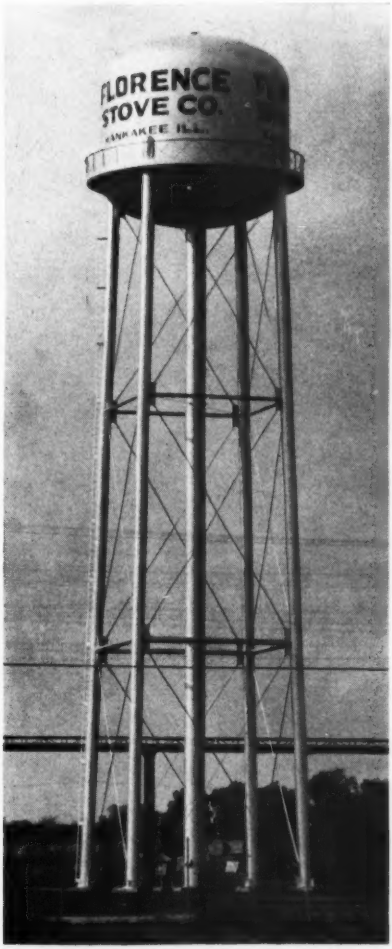
Economy in installation cost and maintenance has dictated the consistent policy of Star Sprinkler Corporation in distributing its Fire Protection Devices through local licensed contractors who have had a lifetime of experience in the installation of automatic sprinkler systems. Operating throughout the United States, Canada and South America, Star licensees, due to their strategic locations, can render instant service. Write us for name and address of Star licensed contractor nearest your location.

STAR SPRINKLER CORP.

Westmoreland and Collins Sts. — Philadelphia, Pa.

. . . A PROFITABLE INVESTMENT in FIRE PROTECTION



The Florence Stove Company has almost doubled the floor area of its Kankakee, Ill., plant during the past six years. As soon as wartime restrictions were removed, they made arrangements to install a 100,000-gal. Horton elevated tank to provide an additional reserve of water to supply the sprinklers in the new section of the plant in case of fire. There isn't much argument about the advisability of such a move, especially with a modern streamline all-welded structure like the one shown at the left.

The installation of the tank reduced insurance costs 4½ per cent. This reduction, when applied to the total valuation of the plant, will make sufficient savings to pay for the tank in a few years. After that the savings will be profit. Furthermore, the supply of water in the tank is ready to flow the instant a fire breaks out and will quench any threatening blaze before it has a chance to gain headway.

Ellipsoidal-bottom tanks with cylindrical columns are built in standard sizes from 50,000 to 500,000 gallons. Write our nearest office for information or quotations.

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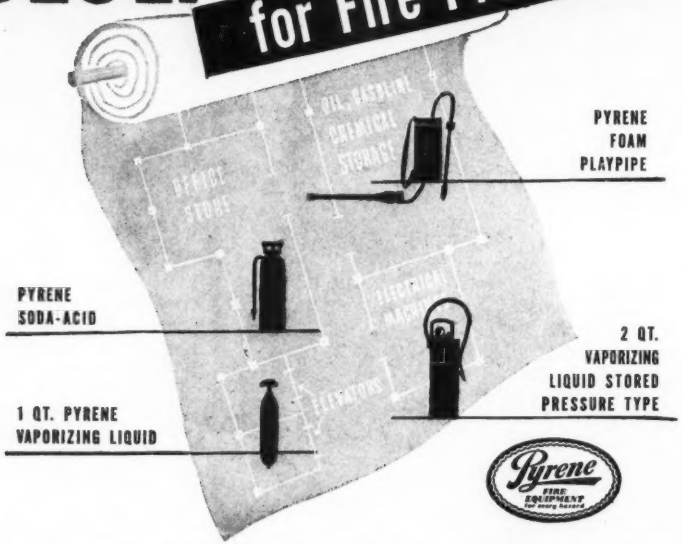
Plants at Chicago, Birmingham and Greenville, Pa.

BLUEPRINT for Fire Protection



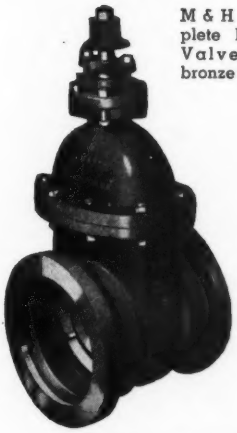
As long as there is one spot in your business not amply protected from fire, your whole investment is in danger. Specific protection for individual risks should be your guide in planning all-around safety.

Pyrene provides an extinguisher for every type and size fire; the Vaporizing Liquid extinguisher for electric equipment, motors, flammable liquids or automotive vehicles . . . Soda-Acid or Water-Type for stores and offices . . . Pyrene Foam for gas, oil, paints, dopes, and solvents, and Pyrene Foam Playpipe and Foam System for producing hundreds or thousands of gallons of foam for big fires.

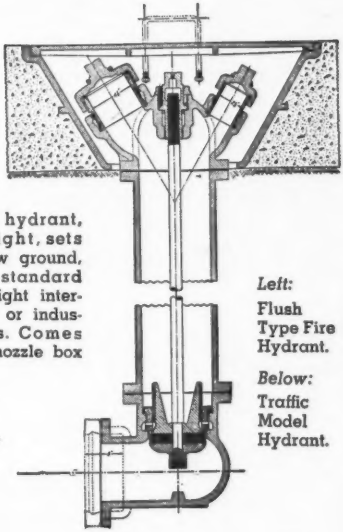
If your protection is inadequate or if you plan to expand, consult your Pyrene jobber. Our engineers are at your service to give you expert advice on protecting your properties.

Pyrene Manufacturing Company
NEWARK 8 NEW JERSEY
Affiliated with the C-O-Two Fire Equipment Co.

VALVES
HYDRANTS
AND PIPE LINE ACCESSORIES



M & H furnishes a complete line of AWWA Valves, iron body, bronze mounted.



Flush type fire hydrant, illustrated at right, sets completely below ground, is used where standard type hydrant might interfere with traffic or industrial operations. Comes with cast iron nozzle box and cover.

Left: Flush Type Fire Hydrant.

Below: Traffic Model Hydrant.

AWWA & UNDERWRITERS APPROVED FIRE HYDRANTS

M & H Fire Hydrants are dry top and revolving head. They are easy to lubricate. Maintenance costs are low due to simplicity of design and rugged construction. They have low friction loss and great efficiency because barrel diameter is not reduced and there are no working parts or obstruction in waterway. Special Traffic model is designed to yield at the ground line under impact. Repair is simple and easy.

M&H VALVE
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Eriez Permanent Magnetic "Humps" Eliminate Fires & Explosions

Installed in *vertical* position, the ERIEZ "Hump" gives complete magnetic protection in gravity-flow or air line chutes.

The ERIEZ *NON-ELECTRIC* **Magnetic "Hump" is a *new* means of easily incorporating complete magnetic protection in air lines or gravity-flow chutes—removing tramp iron from materials in process. The Eriez "Hump" is a complete unit . . . can be immediately installed in lines processing highly combustible fibers, metals, chemicals, powders, sawdust, shavings — or in dust collection systems — where a dangerous tramp iron spark may set off a "flash" fire, or cause a dust explosion.**

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Write today for information on ERIEZ Magnetic Equipment safety features.

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"Central Sprinklers answer the burning question"

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Fire Chief Canvas . . . could have prevented this fire.

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With Fire Chief Finished canvas it would have been different. Fire Chief will not support combustion. The canvas may char a little where the spark contacts it, but will not flame, soon goes out.

On all construction work, the few extra cents for Fire Chief Finished Canvas is cheap insurance . . . soon repaid by longer use, for Fire Chief is water, weather, mildew and wear-resistant, too.

Wherever flammable canvas presents a hazard, specify Fire Chief. Approved by both the Underwriters Laboratories and the Associated Factory Mutual Fire Insurance Companies.

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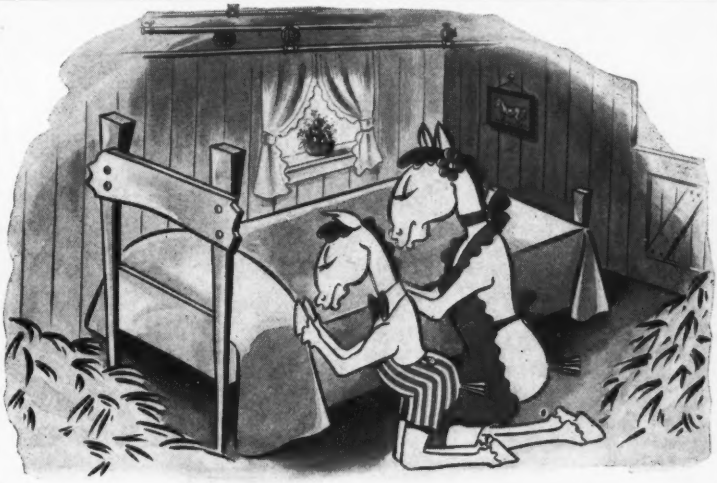
TRADEMARK
U. S. Patents No. 2,044,178, No. 2,299,612 and other patents
HOOPERWOOD COTTON DUCK



We kneel dear Lord in silent prayer,
Ever mindful of Thy guiding care.
We thank Thee Lord as best we're able,
For the "Automatic" Sprinklers
protecting our stable.

Maybe our ode should be entitled "The Horses Entreat" or "The Plugs Plug for "Automatic" Sprinklers".

Definitely certain, however, is the need for proper "fool-proof" fire protection, not only for racing stables, pavilions and the like, but for nearly every type of business establishment.

The tried and proven method of fire protection is the automatic sprinkler.

The tried, proven and entirely "fool-proof" fire protection system is Suprotex*—Rate-of-Rise, the completely "Automatic" System that prevents damage by fire—and water. *It sees and shouts before it fights.*

It will pay you to become acquainted with Suprotex, the best in fire protection. It costs little more, soon pays for itself.

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A famous member of the "Automatic" Sprinkler Family. Provides adequate protection from quench tank, transformer, oil line and other fires of flammable liquid origin.

"Automatic" Sprinkler

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ON THE SPOT!

When fire breaks, action is required, but it must be immediate, EFFICIENT action. FIRETOX is an automatic chemical fire unit which is suspended from the ceiling in danger spots which require constant protection. It employs carbon tetrachloride as the extinguishing medium and ammonia as the motive power. When a fire starts and the unit goes into action, a retaining cap melts, allowing passage for the carbon tet. BUT, Firetox is so precisely consructed that a gold diaphragm, the "Heart of Gold," holds back the extinguishing medium until the precise second when proper pressure has been generated within the unit, then it ruptures and allows the carbon tet to escape against a specially constructed "spreader," which diffuses it over a circular area 12 ft. in diameter. There it gasifies and settles like a blanket, completely smothering a fire. By serving this dual purpose, the heart of Firetox assures maximum fire extinguishing efficiency ON THE SPOT, AT THE RIGHT TIME.

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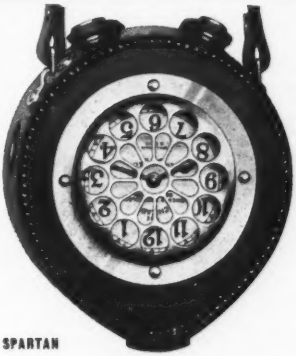
The "Heart of Gold" found in every Firetox unit is a 24-carat gold diaphragm which assures perfect performance, in keeping with the precision action designed by Firetox engineers. In fire protection quality cannot be sacrificed. Firetox IS quality protection against fire.

FIRETOX SYSTEM, INC., 998 Farmington Ave., West Hartford, Conn.

CHICAGO

MINUTE MAN



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CHICAGO WATCHCLOCKS

fill every requirement for size and condition of service in safeguarding you against "human factor" failures in the constant vigilance of your watchmen. . . . A sixty-year record of low cost, reliable performance in every field of industry and all branches of government has established their leadership among watchclock systems.

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FOUR MODELS TO FIT EVERY PLANT PROTECTION NEED

Designed and built by

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The WALDORF-ASTORIA installs draperies that *CANNOT BURN*

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This fabulous dining and dancing spot in the Waldorf-Astoria reflects a new mood of restrained elegance. Shimmering festoons of lustrous, coral toned Fiberglas* contrast with the stark white rococo cornices—provide the exactly right background for carefree entertainment. *Decorated by W. & J. Sloane, Contract Division, New York.*

FIBERGLAS* Listed by Underwriters' Laboratories, Inc., as "Non-Combustible Fabric;" approved by the Bureau of Standards and Appeals, City of New York.

Breathtaking beauty is the keynote of the new Starlight Roof decorative scheme. But more important from a customer standpoint is the fact that these dramatically lovely draperies can help prevent loss of life if a fire should start. For Fiberglas* fabrics are non-combustible—woven entirely of finely spun glass filaments, they never require flameproofing. *Always operate at 100% efficiency.* Endorsed by public safety officials here and abroad for use in all places of public assembly. Now available in luxuriously designed prints and handsome solid colors for theatres, night spots, restaurants, school auditoriums. *See list of sales offices below.*

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* T. M. Reg. U. S. Pat. Off. Owens-Corning Fiberglas Corporation

TO LEARN THIS ABOUT MODERN PROTECTION FOR YOUR PLANT

For instance: valuable records, tracings in vaults or warehouses in isolated, seldom visited spaces could be the starting points for not readily discovered fires that quickly spread and destroy the works. Such spaces should be protected against fire with the new C-O-Two smoke detecting equipment combined with the famous C-O-Two pressure operated fire extinguishing system. To quickly detect and extinguish fires in modern plants, C-O-Two now offers this new, modern, fast-action detection with non-damaging, non-conducting carbon dioxide gas for extinguishing. Without obligation, C-O-Two engineers will confer with you about modern fire protection for your plant. Write us for information today.

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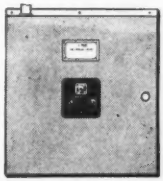
HOSE REEL UNIT



SMOKE DETECTOR

like having a

FIRE DEPARTMENT

IN YOUR OWN PLANT

INDUSTRIAL SPRINKLER SYSTEMS

Viking Sprinkler Systems go into action with the speed of a Fire Department in your own plant. In peace and war Viking Sprinkler Systems are protecting industrial plants across the nation against the universal enemy of production . . . . FIRE. There is a Viking dealer near you to give you all the facts.

VIKING CORPORATION DEALERS

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Von Duprin

THERE TO STAY

When the Von Duprin panic bolt you recommend is put on the door, it is there to stay for the life of the building.

The excess strength of every vital part, together with the extreme simplicity of the Von Duprin mechanism, gives these rugged devices extra long life . . . extra ability to withstand the wear and tear of hard every-day service . . . with no time off for adjustment and repair.

When the emergency comes, the Von Duprin will be on the door, ready to meet the terrific demands of emergency operation.

Made in a wide variety of models to meet almost every exit condition. Details on request.

VON DUPRIN DIVISION
VONNEGUT HARDWARE CO., INDIANAPOLIS 9, IND.

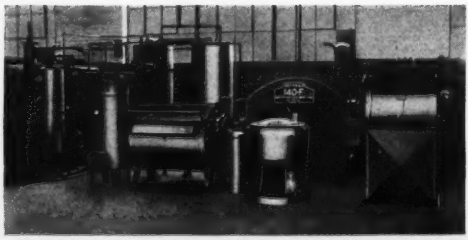
LOOK AT THE RECORD MADE BY HOFFMAN

140-F SAFETY DRY CLEANING

It's a record to be proud of—the clear loss record made by the Hoffman 140-F drycleaning system, in hundreds of installations during the past six years! The point is—this is Petroleum Solvent Equipment—not a chlorinated solvent unit! It's the original Safety Petroleum Solvent Unit—an exclusive U. S. Hoffman development to promote greater safety in the drycleaning industry. An approved Class III system, the 140-F complies with standards of National Board of Fire Underwriters Pamphlet No. 32. Most inspection departments permit installation without enclosing walls.

USES 140° FLASH PETROLEUM SOLVENT

The Hoffman 140-F drycleaning system employs safety solvent with flash-point of approximately 140° F. The system is offered to the drycleaning industry in 12 different types—each one tested and listed by the Underwriters' Laboratories Re-examination Service.



U. S. HOFFMAN MACHINERY CORPORATION
105 Fourth Ave., New York 3, N.Y.
DRY CLEANING, LAUNDRY & GARMENT PRESSING EQUIPMENT

PETROLEUM
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All fully protected from fire by NATIONAL FOAM

Complete protection given American Business by mechanical (Aer-o-foam) and chemical foams and equipment.

FULL PROTECTION from fire is National Foam System's guarantee to American business and industry. Generations of fire-fighting "know-how" put National Foams and equipment on watchful guard 'round the clock. Specific hazards are met by definite measures—engineered to your particular problems.

National Foams, fire protection specialists, smother flames by thick, tough, enduring foam blankets quickly applied. Threatened areas are insulated; flashbacks are blocked. National Foams stick to angles as well as flowing freely over flat areas, thoroughly sealing off fire-feeding gases.

National Foams and equipment protect dip tanks and spray booths, petroleum installations, marine hazards, chemical plants, planes and hangars—American commerce afloat and ashore. National's engineers diagnose the problem, prescribe complete fire protection.

Write, wire or phone today for what trained technicians can do for you. There is no substitute for fire-fighting experience.

NATIONAL FOAM SYSTEM, INC.
SPECIALIZING IN TODAY'S FIRE PROTECTION
Packard Building, Philadelphia 2, Pa.

What's **DIFFERENT** *about Globe Protection*

The Most Modern of Dry Pipe Valves

Globe Model "AD"

FIRST DRY PIPE VALVE requiring but 15 lbs. air to withhold any water pressure and with an unchangeable tripping point which remains CONSTANT regardless of water pressure. Low air pressure is easier to confine and is more quickly exhausted, speeding the water to the fire.

FIRST DRY PIPE VALVE without an intermediate (atmospheric) chamber — therefore self-priming, having only one seat on the underside of which water is always present.

FIRST DRY PIPE VALVE — size of a standard check valve — which reduced size and weight permits factory assembly with trimmings, assuring uniformity and no field adjustment.

DESIGNED SIMPLICITY — BEST FOR SPRINKLER DEVICES

GLOBE

Automatic Sprinkler Co.

2035 WASHINGTON AVENUE

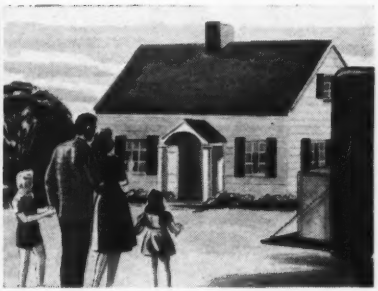
Philadelphia 46, Pa.

SALES OFFICES IN PRINCIPAL CITIES

Will you wake up with *HALF A HOUSE?*

John Parker believed in insurance. Seven years ago, he bought a home—and fire insurance to cover it, complete with extended coverage. His renewals came in regularly. Both he and his insurance agent relaxed with a nice feeling of security.

Then, disaster struck! When the ashes were raked away, he found the insurance settlement would only rebuild *half* the house. Building and replacement costs had increased 30% to 50% since 1939—and were still going up. It was the same with furnishings.



So, he pared off a room here . . . doubled up the children there . . . planned to add a wing later. He discovered that half a house was better than none—but not *much* better. He still believes in insurance. But he's pretty sour on the whole situation.

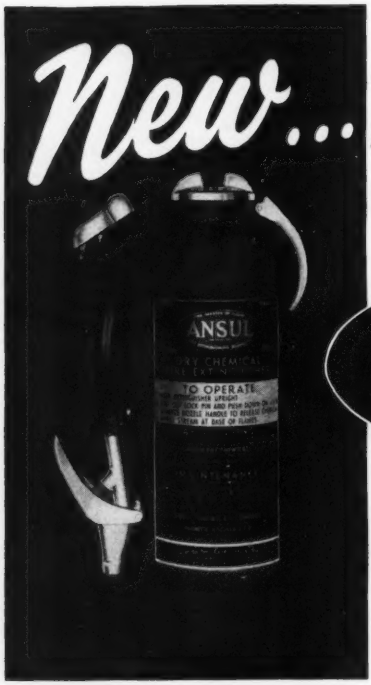
Is *your* property adequately insured?•Will you ever wake up with half a house? Better see your insurance agent or broker now. Better make sure that your Fire Insurance is adequate to take care of present high replacement costs.

AUTOMOBILE INSURANCE COMPANY
STANDARD FIRE INSURANCE COMPANY
HARTFORD, CONNECTICUT

Fire and Marine Insurance • All Forms

Affiliated with

ÆTNA LIFE INSURANCE COMPANY • ÆTNA CASUALTY AND SURETY COMPANY



New... FASTER

FIRE STOPPING POWER WITH

THE MASTER OF FLAME
ANSUL*
*REG. U.S. PAT. OFF.
FIRE EXTINGUISHING EQUIPMENT
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DRY CHEMICAL
FIRE EXTINGUISHERS

- Greatly increased fire-killing capacity.
- Simplified operation.
- Expert performance by inexperienced operators.
- Quick, easier on-the-spot recharge after use.
- More fire stopping power pound for pound, dollar for dollar.
- Greater heat-shielding protection for operator.
- Increased fire-fighting capacity without increased weight.
- Engineered to resist corrosion.

Install the NEW Ansul-Dugas Extinguishers at all hazard spots for greater protection against all fires involving flammable liquids, gases and electrical equipment.

Ready . . . in a Flash!

Simply remove ring-pin and push lever down.

Open nozzle and direct chemical stream at base of flames.

53% More Fire Stopping Power with the NEW FASTER ACTING ANSUL-DUGAS FIRE EXTINGUISHERS

Listed and Approved by Underwriters' Laboratories and Factory Mutual Laboratories

Write today for new catalog and authoritative data showing characteristics of all types of approved hand fire extinguishers.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION • MARINETTE, WIS.

RELIABLE

SUPERFINE

AUTOMATIC SPRINKLER DEVICES

Are excellent in design and construction — have a perfect field record — are universally approved by all Fire Insurance and Governmental Authorities — and effect maximum reductions in fire insurance premiums.

Comprise a complete line including Automatic Sprinklers, Open Sprinklers, Alarm Valves, Dry Pipe Valves, Circuit Closers, Water Motors and all other accessories required in Sprinkler Systems. Other fire protection devices and materials also furnished.

Reliable Sprinkler Equipment now protecting thousands of properties throughout the United States, Canada, and the world.

Write Us For Further Particulars
Manufactured and Distributed by

The Reliable Automatic Sprinkler Co., Inc.

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GENERAL Offers:
Protection for Every Fire Hazard
* GENERAL has eight conveniently located branch factories and warehouses, sixteen branch offices at your service, plus a nation-wide network of independent distributors.
There is a right GENERAL extinguisher for every fire hazard—and this right extinguisher should be the one located near that hazard. Protect your life and property. Make sure you have the correct GENERAL fire fighting equipment.
Through its branch offices and warehouses in every section of the country, General Detroit serves every major American industry. A GENERAL representative is nearby to serve you. Do not hesitate to call on him for advice and dependable fire protection apparatus. Write for your free copy of General Detroit's File Reference Folder which tells where to use each type of extinguisher.
S-O-S Fire Guard
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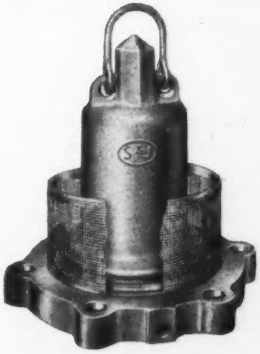
It's "TOP REMOVABLE"!

When you wish to remove the new Type MS Internal Safety Valve from a tank compartment for servicing, it is not necessary to dismantle any piping underneath the tank. Valves which have to be removed through the tank bottom present many problems which we have overcome by designing a valve which may be removed through the dome cover, using a standard socket wrench. Write for a copy of our new catalog No. HVS-4 and learn of other new features of this safety valve.



The valve shown above may be operated by hydraulic pressure, or by air pressure from the truck air brake tank.

S&J

SHAND & JURS CO.

BERKELEY, CALIFORNIA

NEW YORK CHICAGO HOUSTON LOS ANGELES SEATTLE

SHAND & JURS

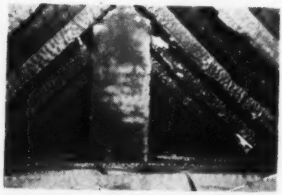
TOTAL LOSS AVERTED BY WaterFOG

Bad Rural Class A Fire with Half-Hour Start Extinguished by Two Rockwood SG-40 Nozzles in 20 Minutes . . . with only 50 psi Nozzle Pressure.

Fire in the Morgan home at Wilbraham, Mass., started in upper bedroom. Firemen entered by ladder through second-floor window.

More and more fire departments and industrial plants are adding WaterFOG to their straight-stream facilities. SG-40, the triple-action nozzle, *provides both* — discharging high-velocity WaterFOG, low-velocity WaterFOG from extension applicator, or straight stream. Approved by Underwriters' Laboratories, Inc., and Associated Factory Mutuals.

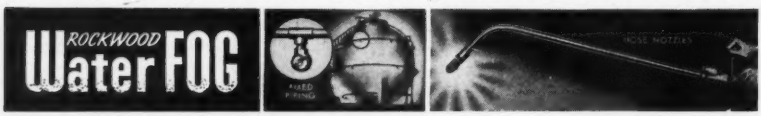
Write for Bulletin C-501 on the SG-40 Nozzle, and Bulletin 123, describing how WaterFOG puts out fires faster, protects men and equipment, reduces water damage. Natural-color movies (16-mm.) also available. ROCKWOOD SPRINKLER COMPANY, 56 Harlow Street, Worcester 5, Massachusetts. Specialists in Fire Protection Engineering, Equipment and Installation since 1907.



Deep charring in attic shows headway gained by fire before application of WaterFOG.

View of living room shows little fire or water damage below second floor.

Water Engineered by Rockwood Cools, Confines, Smothers Class "A" and Oil Fires



Eliminate

Delayed Alarms

Reduce

Fire Losses

WHEN FIRE OCCURS

Call the Fire Department. Delay creates unnecessary fire waste and life hazard

Fire Alarm Boxes
Save Time and Protect Life, Property and Income

Write for details

THE GAMEWELL COMPANY

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The complete line of Grinnell Fire Protection Equipment makes it easy to select just the right type for any particular hazard. Each type is backed by our experience of over 75 years as pioneers in the fire-fighting field.

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  Where Temperatures Are Above Freezing
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  Where Temperatures Go Below Freezing
- **SIMPLEX DRY-PIPE SYSTEM**
  For Light Hazards and Limited Water Supply
- **MULTITROL SYSTEM**
  Detection-Warning-Protection
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  Assures Faster Application of Water to Fire
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  Extinguishes Fires in Flammable Liquids
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- **FLAMEBUSTER**
  An Auxiliary to Fixed Protection

Complete information on Grinnell Fire Protection Systems and Equipment is yours for the asking from Grinnell Company, Inc., 277 West Exchange Street, Providence 1, R. I. Offices in principal cities.

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